Deactivation and Decommissioning Focus Area

QUARTERLY REPORT – OCTOBER 2000

July – September 2000 Activities

Office of Science & Technology

NETL

D&D Focus Area

On the Cover

Upper Left–Right:

The contract for delivery of the **Keibler-Thompson KT-30 Remote Controlled Demolition Machine**, was made by Savannah River Site.

The Fernald team has has been responsible for the deployment of 104 **Personal Ice Cooling Systems (PICS)** to 17 sites through this Accelerated Site Technology Deployment (ASTD) project.

Lower Left–Right:

The treatment of water, to remove Cs-137 and Sr-90, at Savannah River's R-Basin is being accomplished with two technologies: 1] the **3M Selective Seperation Cartridge** and 2] the **Selion/Graver Ion Exchange**.

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The purpose of this document is to provide an overview of the Deactivation and Decommissioning D&D Focus Area and to update readers on the program's current activities. It presents a synopsis of the current program status and recent accomplishments, along with overviews of planned activities, program issues, and opportunities. Quarterly reports are distributed to U.S. Department of Energy DOE headquarters and operations office managers, site personnel, site operating contractors, technology developers, principal investigators, regulators, and other stakeholders. Issued in January, April, July, and October, the D&D quarterly reports summarize the activities of each preceding quarter. The D&D Update is published in all other months, introducing new projects and highlighting advances in ongoing projects. Quarterly reports, monthly updates, and further information about the D&D Focus Area DDFA are found on the World Wide Web at *www.netl.doe.gov/dd*. Technologies are usually identified by their discrete tracking numbers within the Technology Management System TMS operated by DOE's Office of Science and Technology OST. Providing access to information about OST programs, technologies, and linkages to EM problems, TMS is found on the World Wide Web at *ost.em.doe.gov/tms/home/entry.asp*.

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1.0 HIGHLIGHTS

Successful Treatment of Water at Savannah River's R-Basin Opens Doors for Further Technology Deployments

A future look at R-Reactor at the Savannah River Site

Two parallel deployments of improved water treatment systems at Savannah River's R-Basin are successfully treating large volumes of cesium and strontium contaminated water and saving millions of dollars in cleanup costs.

The side-by-side deployment of 3M's Selective Separation technology and the Selion/Graver Ion Exchange technology is a result of the combined efforts of EM's Office of Science and Technology, the Deactivation & Decommissioning Focus Area, and the Savannah River Site (SRS). The two innovative technologies were deployed through the Accelerated Site Technology Development (ASTD) program.

In 1992, the last of the five DOE production reactors at SRS was placed into shutdown mode, with no intention to restart. Approximately 5 million gallons of radionuclide-contaminated water still remains in each of the C, P, and R-Reactor Disassembly Basins and the integrity of these basins has increasingly become a concern. Rather than remove and transport the contaminated water for treatment, new technologies have been deployed (in situ treatment), which will greatly mitigate risk and reduce basin closure costs.

Treatment of the R-Basin water using 3M's Selective Separation Cartridges™ (SSC) started in May 2000. SSC uses membrane technology fabricated into spiral-wound, cartridge filters. The system is designed to remove specific radionuclides from aqueous solutions at high flow rates. The Selion/Graver Ion Exchange technology (SGT) began treating basin water in June 2000. SGT uses a down-flow packed bed column, allowing ion exchange to selectively separate the targeted radionuclides.

The objective of the in situ treatment is to remove the majority of the Cs-137 and Sr-90 with systems that require passive operation. The systems, working in parallel, are operated around the clock, seven days a week, with limited operator coverage.

Initially, it was estimated that 5 million gallons of water would take 6-8 years to process at a cost of $5.5 million employing the site's baseline approach. In comparison, the in situ technology deployments are expected to cost a total $1.5 million, resulting in a short-term, $4 million savings. The projected completion date for the Cs removal, with both systems, is around March 2001. Sr removal using the SGT will be completed around May 2001.

3M Selective Separation Cartridge™ deployed at R-Reactor Disasembly Basin

Gravier/Selion deployment at Savannah River Site.

To date, the SSC system has processed 1.8 million gallons of water while removing more than 99 percent of Cs-137. The Cs-137 removal system is still running on the original SSC filters with only pre-filters needing replacement. The SGT has processed 725,000 gallons, while removing approximately 99% of Cs-137 with only one change out of the 1-micron pre-filters. A draft Cost & Performance Report has been developed for the technologies, and it is currently being reviewed. Once final, the report will be widely distributed and posted on the DDFA's webpage in order to support furthers deployments.

Subsequent to water treatment at R-Basin, additional deployments of the technology are anticipated at Savannah River "C" and "P" Reactor Disassembly Basins, and at other similar water processing projects across the DOE complex.

The project's success is a direct result of the partnership between EM's Office of Science & Technology, the D&D Focus Area and the Savannah River and the committed efforts of all parties involved. New partnerships will lead the way in enhancing the potential for reduction of cleanup cost across the DOE weapons complex.

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D&D Focus Area Finds a Gem Working in the Steel Mills

The D&D Focus Area continually seeks out innovative technologies to provide solutions to needs across all DOE sites. Occasionally this happens by finding a vendor with the right equipment and service capabilities to meet site-specific needs and requirements. The new Keibler-Thompson Corporation is one such company. Their history and experience was gained from the steel-making and chemical process industries where they provided specialized equipment engineered and designed to remove the worker from the hostile environments. The equipment was built to stand up to the harshest, hottest, most-demanding work environments with limited access. This demands capabilities in remote operations and reliability, very similar to the requirements of nuclear demolition.

In October 1999, Keibler-Thompson was invited to Morgantown to meet with DDFA Program Managers to discuss the unique features of their demolition equipment, engineering staff, and skilled operators. Early this year, the capabilities of their KT-30 Remote Controlled Demolition Machine were demonstrated at the Florida International Universities (FIU) facilities. There, Keibler-Thompson received the highest rating possible. According to the Hemispheric Center for Environmental Technology (HCET) of FIU on their assessment of the KT-30, "The technology successfully and efficiently demolished the concrete structure as specified. The technology successfully and efficiently dismantled the metal structure members. It appears to

> *"...It appears to be a robust and reliable technology for dismantlement and demolition work."*
> *HCET assessment of KT-30*

be a robust and reliable technology for dismantlement and demolition work."

Recently, Keibler-Thompson was awarded their first contract for sale of equipment at the Savannah River Site. The contract was for delivery of their KT-30 Remote Controlled Demolition Machine. Westinghouse Savannah River wanted to acquire a diverse, rugged, and versatile piece of demolition equipment for overhead pipe dismantlement, cutting of structural steel, rods, and other forms of carbon and stainless steel. The equipment needed the capability of being operated by remote control.

The diversity and ruggedness of the equipment and the ability of KT's engineering/service staffs to adapt the equipment to specific needs will make Keibler-Thompson an attractive player in nuclear site cleanup.

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2.0 Project Summary Table

The following table summarizes the Technical Task Plans for the D&D Focus Area Core Program and related Crosscutting and Industry Program contracts. Project descriptions follow in subsections 2.1 through 2.5 and are organized by the work breakdown structure WBS element listed here.

Project Number	D&D WBS Element	Project Name	Page
AL08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Los Alamos National Laboratory Transuranic Waste	8
OH08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Mound Tritium Facilities	9
ID08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Idaho National Engineering and Environmental Laboratory Fuel Storage Canals and Underwater and Underground Facilities	11
RL08DD21	Demonstrations and Industry Approaches	Canyon Disposition Initiative	13
SR09DD61	Demonstrations and Industry Approaches	Highly Selective Nuclide Removal System—Accelerated Site Technology Deployment	14
OH19DD61	Demonstrations and Industry Approaches	Mobile Work Platform—Accelerated Site Technology Deployment	14
RL09DD61	Demonstrations and Industry Approaches	Remote Size Reduction for Large Hot Cell Deactivation—Accelerated Site Technology Deployment	15
NV09DD62	Demonstrations and Industry Approaches	Surface Contamination Monitor—Accelerated Site Technology Deployment	16
AL08SD10	Demonstrations and Industry Approaches	Los Alamos National Lab Decontamination and Volume Reduction System—Accelerated Site Technology Deployment	—
NV09DD61	Demonstrations and Industry Approaches	Oversize Transuranic Waste Laser Cutting System, Nevada Test Site—Accelerated Site Technology Deployment	17
OH19DD62	Demonstrations and Industry Approaches	Personal Ice Cooling System—Accelerated Site Technology Deployment	17
ID08SD11	Demonstrations and Industry Approaches	Integrated Decontamination & Decommissioning—Accelerated Site Technology Deployment	18
ID79DD61	Demonstrations and Industry Approaches	Release of Concrete for Recycle from D&D Projects—Accelerated Site Technology Deployment	19
CH39DD63	Demonstrations and Industry Approaches	Deployment of Innovative Characterization Technologies and Implementation of the MARSSIM Process at Radiologically Contaminated Sites—Accelerated Site Technology Deployment	21

Project Number	D&D WBS Element	Project Name	Page
RF09D21 RF08SD10 RF09DD61	Demonstrations and Industry Approaches	Rocky Flats Environmental Technology Site—Accelerated Site Technology Deployment and the D&D Initiative	22
	Demonstrations and Industry Approaches	Deactivation and Decommissioning Consortium	26
Multiple Projects	Demonstrations and Industry Approaches	Florida International University	27
Multiple Projects	Demonstrations and Industry Approaches	AEA Technologies DDFA Projects	28
CH15C251	Facility Characterization	Portable X-Ray, K-Edge Heavy-metal Detector	31
NV05C253	Facility Characterization	Airborne and Ground-Based Laser-Induced Fluorescence	—
DE-AC21-93 MC30176	Facility Characterization	Three-Dimensional Integrated Characterization and Archiving System	32
DE-AR26-98 FT 40365	Facility Characterization	Fast Response Isotopic Alpha Continuous Emissions Monitor	33
DE-AR21-94 MC30359	Facility Characterization	Laser Ablation of Contaminants from Concrete and Metal Surfaces	—
DE-AR26-98 FT 40367	Facility Decontamination	High Productivity Vacuum Blasting System	34
DE-AC21-93 MC30170	Facility Dismantlement and Material Disposition	Advanced Technologies for Decontamination and Conversion of Scrap Metal	—
DE-AR21-93 MC30362	Facility Dismantlement and Material Disposition	Asbestos Pipe-Insulation Removal System BOA	35
Multiple Projects	Facility Dismantlement and Material Disposition	Robotics Crosscutting Program	36
DE-AC21-93 MC30179	Worker Safety/Other	Protective Clothing Based on Permselective Membrane and Carbon Adsorption	38
DE-AR26-97 FT34314	Worker Safety/Other	Robot Task Space Analyzer	39
FT06IP01	Worker Safety/Other	Integrated D&D Decision Analysis Tool	40
DE-AR26-98	Worker Safety/Other	Modular Manipulator for Robotic Applications	41

2.1 Demonstration and Industry Approaches

LANL TRU Waste Characterization, Decontamination and Disposition LSDDP

Objective and Scope: The Los Alamos National Laboratory (LANL) TRU Waste Characterization, Decontamination and Disposition Large Scale Demonstration and Deployment Project (LSDDP) addresses the characterization, decontamination and volume reduction of oversized metallic transuranically contaminated (TRU) waste currently in storage at LANL's storage and disposal area, TA-54. The LANL LSDDP reflects the cooperative interest of industry, government, and academia to bring collaborative expertise and strength to DOE's TRU decontamination and decommissioning program at LANL and elsewhere within the DOE complex. LANL currently has 1,500 m^3 of TRU waste in inventory, 313 plutonium-contaminated gloveboxes in a 24,000 ft^2 facility, and expects to generate another 2,500 m^3 from ongoing operations in coming years.

The major objectives of this LSDDP are to:

- Deployment for the characterization, decontamination and volume reduction of TRU waste/TRU contaminated metallic objects
- Identify technologies that are ready for demonstration
- Demonstrate those technologies with potential to reduce cost, risk and schedule and that are amenable for direct field application at Los Alamos and elsewhere in the DOE complex
- To the extent possible, compare technologies "side by side" with baseline approaches to evaluate their advantages (cost, risk, schedule) and refine/validate baseline assumptions
- Capitalize on the combined corporate management and technical strength of private industry, government and academia
- Demonstrate a leveraged funding pool of federal and private monies via cost sharing to address issues of national importance
- Provide ready access to demonstration results through an aggressive communication program

Crates of plutonium-contaminated gloveboxes stored at Los Alamos National Laboratory (LANL) are destined for permanent disposal at the Waste Isolation Pilot Plant (WIPP)

Status and Accomplishments:

The LANL LSDDP has demonstrated the following five technologies to date: the AeroGo air pallets, the SAIC Vehicle and Cargo Inspection System (VACIS) for RTR of crates, the Mobile Characterization Services transportable X-Ray for RTR of crates, the Nukem RASP for sectioning gloveboxes, and the Mega-Tech hydraulic cutter.

Mega-Tech hydraulic cutter.

Current Reporting Period Activities:

The newly developed security camera system, NTvision, was positioned in the PermaCon in TA-54 for a demonstration on low-level waste (LLW) package record keeping. The test plan was completed and the demonstration was initiated in September. The demonstration will be completed in October 2000.

Other activities included:

- Initiated development of test plan for the ThermoPower FastCAM
- The EMEC electrochemical decontamination technology was reviewed for

demonstration and declined by Technology Selection Committee (TSC), as it is not ready for demonstration.

- Planning for a joint U.S. Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) (Russian scientists) meeting on plutonium glovebox D&D was initiated in a meeting with DDFA during the Spectrum 2000 meeting.

For more information:

http://www-emtd.lanl.gov/LSDDP/DDtech.html

Tech ID 2203

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Mound Tritium D&D LSDDP

Objective and Scope: The Mound Plant in Miamisburg, Ohio began operations in 1948. The site's mission, originally to fabricate the neutron initiator for the atomic bomb, expanded to include research, development, and production of numerous nuclear and nonnuclear weapons components, production of radioisotopically fueled thermoelectric generators and surveillance of nuclear weapons components.

The objective of the Mound Tritium D&D LSDDP is to identify, demonstrate and evaluate innovative technologies applicable to the decontamination and decommissioning (D&D) of tritium facilities. D&D of Mound's surplus tritium facilities, the T and R/SW Buildings, provides a unique opportunity to compare, evaluate, and eventually execute innovative D&D technologies alongside baseline technologies in an ongoing project. The Mound LSDDP will identify and explore methods to improve worker safety while achieving cost and schedule savings. The project is expected to identify technologies that, when implemented in the Mound LSDDP, will produce significant savings on the $57.8 million baseline. The results and successes of this demonstration project will benefit similar DOE facilities and projects.

The Mound Plant, Miamisburg, Ohio commenced operation in 1948.

The Technical (T) Building is an underground reinforced-concrete structure built in 1948 for the purification of polonium-210 used in nuclear weapons initiators. Later the facility was used to extract other radionuclides, house the plutonium verification facility, and store TRU materials. Facilities large enough to handle multikilogram quantities of tritium were added to the building. Current plans are to decontaminate T Building to potentially allow unrestricted public reuse by the year 2003. The SW Complex and one corridor of rooms in the adjacent R Building form the SW/R Complex. Four types of operations have been performed in these facilities to support nuclear weapons programs using tritium: component development, component evaluation operations, tritium recovery, and material analysis. To meet DOE's vision of completing the environmental restoration of the site by 2005, the SW/R Tritium Facilities will be demolished, and contamination beneath the building will be removed.

It is anticipated that innovative technologies will be applied to the following decontamination tasks:

- tritium-contaminated gloveboxes
- tritium characterization techniques
- productivity improvement technologies
- tritium specialties decontamination
- piping system removal and disposition
- mixed waste treatment and disposal
- tritiated water treatment
- contaminated water plume under SW building

- miscellaneous rad/non-rad traditional building materials disposition

The Mound LSDDP IC Team includes Babcock & Wilcox of Ohio, Lawrence Livermore National Laboratory (LLNL), British Nuclear Fuels Limited (BNFL), Foster Wheeler, IT Corp, LANL, Westinghouse Savannah River, Princeton Plasma Physics Laboratory (PPPL) and FIU.

Status and Accomplishments:

Completed Demonstrations:

1. Portable Scintillation Counter (Tech ID 2311): The Lumi-Scint portable scintillation counter is a portable, single-tube liquid scintillation counter that can be set to respond to the low-energy beta radiation from tritium. It uses a single photomultiplier tube and manual sample chamber. The Lumi-Scint can be run from an internal battery or 110 VAC for its operation. The unit can be obtained with a printer, which allows hard copies of its electronically stored data.

2. Water Solidification (Tech ID 2312): This technology uses polymer-based absorbent (Waterworks SP-400) that can be used to solidify aqueous waste. It is similar to other polymer-based absorbents that offer benefits over traditional solidification agents such as cement or the Mound facility baseline solidification agent Aquaset. Benefits include a high liquid-to-absorbent ratio; no mechanical mixing required to promote the absorption process; little to no volume increase in the waste form after addition of the absorbent; and a very high retention in the form of the gel-like material.

3. Oil Solidification (Tech ID 2313): This contaminated oil solidification technology—NOCHAR Petrobond®—is a high-quality polymer offered by NOCHAR®, Inc., of Indianapolis, Indiana, and is specifically designed as a petroleum-based liquid absorbent. The Petrobond® absorbs very quickly with little increase in volume. The Petrobond® can be used for free-liquid control in storage, transport, and disposal of low-level radioactive waste.

4. Tritium Clean-Up Cart (Tech ID 2974): The Tritium Clean-Up Cart is a portable tritium Processing System Clean-Up Cart. Used as a stand-alone cart for scrubbing tritium effluent, it provides a scrubbing process based on catalytic oxidation of tritium. Tritiated water is collected on removable molecular sieve dryers, which can be shipped as low level waste below the 1080 curie "Type A" limit. The unit provides a projected decontamination factor of greater than 1000, with a process flow rate of 45 l/min. Design features include: mole sieve dryer beds configured in series with moisture monitors to prevent moisture breakthrough; process flow controllers in the main plumbing loop and air inlet system; process thermocouples, which provide process stream and enclosure overtemperature control; and an enclosure that can function as a ventilated hood during normal operating conditions, but can be isolated when tritium concentrations inside the enclosure exceed the pre-selected control setpoint.

5***. Pipe Cutting and Crimping System (Tech ID 2955)***: The Pipe Cutting and Crimping System is a small hand-held, battery operated crimping tool manufactured by Burndy Products. This tool utilizes a separate hydraulic pump with a high-pressure hose connected from the pump to the crimping head. U-shaped dies are contained in the head for crimping. A battery-powered hydraulic pump or electric-powered pump can be used to develop 10,000 psi of pressure to the crimping head. A total of 30 crimping operations can be performed before recharging is needed. The small dimension and light weight make this tool very suitable for crimping in tight quarters.

Current Reporting Period Activities:

In August, the Mound Tritium D&D LSDDP team initiated demonstration of the Fiber Optic Tritium Detector and Quantifier. This technology, developed by McDermott Technologies, Inc., uses a fiber optic bundle

The Tritium Clean-Up Cart was demonstrated as part of the Mound LSDDP

coupled to a photomultiplier tube detector to measure low energy beta radiation from radioactive decay of tritium. It allows the fiber bundle to be introduced directly in the liquid (oil or water) sample for tritium detection and quantification. During August and September, calibration tests were conducted for the equipment. A calibration curve will be established based on these tests that will be used later during the demonstration on larger waste streams.

In September, the project team also completed demonstration of the TechXtract decontamination technology. This technology uses proprietary chemical solutions for volumetric decontamination of metals. It was tested for removal of tritium on highly contaminated pieces of equipment at PPPL.

Also, during September, demonstration of the Self-Assembled Monolayers on Mesoporous Support (SAMMS) heavy metal adsorbent was conducted at Mound. The SAMMS technology was developed by the Pacific Northwest National Laboratory (PNNL) for removal and stabilization of RCRA metals (i.e., lead, mercury, cadmium, silver, etc.) and for removal of mercury from organic solvents. The SAMMS material is based on self-assembly of functionalized monolayers on mesoporous oxide surfaces. The unique mesoporous oxide supports provide a high surface area, thereby enhancing the metal-loading capacity.

The SAMMS material has high flexibility in that it binds with different forms of mercury, including metallic, inorganic, organic, charged, and neutral compounds. It removes mercury from both organic wastes, such as pump oils, and from aqueous wastes. Mercury loaded SAMMS material not only passed toxicity characteristics leaching procedure (TCLP) tests, but also has good long-term durability as a waste form because: 1) the covalent binding between mercury and SAMMS has good resistance in ion-exchange, oxidation, and hydrolysis over a wide pH range, and 2) the uniform and small pore size of the mesoporous silica prevents bacteria from solubilizing the bound mercury. SAMMS material was added to existing containers of tritiated oil and thoroughly mixed to adsorb the heavy metals in the oil. A filtering phase removed the SAMMS material with adsorbed heavy metals, in a filter cake waste form (sludge), suitable for disposal. No secondary wastes requiring clean up were generated during the application of SAMMS, because no chemicals, washing solution, regeneration, and secondary treatment are involved. The RCRA metal-laden SAMMS material can be directly disposed of as non-hazardous solid wastes.

For more information:

http://www.doe-md.gov/lsdd/lsdd.htm

Tech ID 2201

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INEEL Fuel Storage Canals and Associated Facilities D&D LSDDP

Objective and Scope: The Idaho National Engineering and Environmental Laboratory (INEEL) Fuel Storage Canals and Associated Facilities LSDDP is led by an IC Team consisting of Parsons Engineering, BNFL, BBWI, TLG Engineering, FIU, and Idaho State University. This LSDDP will utilize funding, technologies, and expertise from the Offices of Environmental Restoration, Science and Technology, and Nuclear Material and Facility Stabilization; industry; universities; and the international community.

The project includes the following areas:

- *Test Reactor Area TRA-660*, housing two underwater research reactors, the Advanced Reactor Measurement Facility and the Coupled Fast Reactivity Measurement Facility, with a 30,000-gal interconnecting water canal that was sometimes used for fuel storage. These facilities were utilized for reactivity insertion experiments that were later scaled up for experiment design in larger reactors.

The two reactors achieved criticality in 1960 and 1962, respectively. Neither has operated since February 1991. Contamination includes radioactive elements, lead, and chromium.

- *TRA Filter Pit system*, consisting of five structures containing large filters associated with test reactor operations. The facilities are contaminated with lead, radioisotopes, and deteriorating asbestos. The filters are located in restricted entry pits, and D&D work will have to be done remotely and in confined spaces.
- *Test Area North TAN-620 Initial Engine Test Control Room*, a massive underground, shielded, heavily reinforced concrete structure that served as the control center for the engine tests in the Aircraft Nuclear Propulsion Program conducted at the INEEL in the late 1950s and 1960s. Contamination includes asbestos, mercury, lead, and some potential radiation.

This LSDDP is a high priority for the DOE/Commercial Nuclear Utilities D&D Consortium, with demonstrated technologies having deployment opportunities in the nuclear utility market through the consortium. Resulting deployments throughout the DOE complex alone could generate a potential cost savings and mortgage reduction of $20 million.

Eleven to 18 innovative and improved technologies will be demonstrated in the areas of underwater inspection, characterization, and dismantlement; inspection, characterization, and dismantlement in restricted spaces; recycle of materials from D&D activities; removal of loose radiological contamination on walls, floors, piping, and equipment; removal of fixed radiological contamination on concrete; tank, vessel, and piping decontamination; lead plate radiological decontamination; and high-radiation exposure fields.

Current Reporting Period Activities:

The Global Positioning Radiometric Scanner (GPRS) system, which was demonstrated in a previous reporting period, was deployed several times during the reporting period at Test Area North and the Radioactive Waste Management Complex (RWMC).

The In Situ Object Counting System (ISOCS) for free release of decontaminated areas (IFR) was initiated in October 1999 and was completed on August 30, 2000. Using the ISOCS for free-release (IFR) resulted in a 75 percent savings in labor, eliminated the physical demands of hand surveying and provided 100 percent inspection not available with gridding and hand surveying, which is the comparable baseline technology. This was the fourteenth and final demonstration for the INEEL LSDDP this fiscal year and satisfied the objective of demonstrating 11 to 18 technologies during the course of the LSDDP.

The INEEL is currently working with DOE and the Research and Development Institute of Construction Technology (NIKIMT) in Moscow, Russia, to demonstrate a Russian technology. The technology is a non-tethered 3D-Gamma Locator Device (GLD) that provides three-dimensional characterization of radioactivity in areas of high levels of radioactivity. It is a robotic unit that provides results to a computer-based control system. The first phase testing of the technology was successfully accomplished, during an earlier period, in Russia. Work is proceeding to bring this technology, with an isotopic analyzer, to the INEEL for demonstration in mid-November 2000.

For more information:

http://id.inel.gov/lsddp/

Tech ID 2202

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Canyon Disposition Initiative

Objective and Scope: The Hanford Canyon Disposition Initiative (CDI) Project is a collaborative project that initially included participation across the DOE Office of Environmental Management (EM). Participating EM offices included the Offices of Waste Management Environmental Restoration, Science and Technology, and Nuclear Material and Facility Stabilization. This partnership was driven by the broad and significant impact that decisions made on the disposition of the canyons would have to all of these programs. Due to the reorganization of EM in September 1999, CDI is being overseen by the newly created Office of Project Completion.

The CDI Project is evaluating the feasibility of using the five chemical processing facilities (canyons) as assets for disposal of low-level wastes, instead of a mortgage liability. The 221-U Facility is being used as a pilot for this evaluation. The DOE Richland Operations Office (RL) Environmental Restoration Program signed an Agreement in Principle with the regulators at the beginning of FY 1997, to conduct the evaluation for the disposition alternatives for the canyon facilities. In 1996, a Canyon Task Team of personnel from RL, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology (known as the Tri-Parties) conducted a series of workshops to identify an approach for the long-term disposition of the five main processing facilities in the 200 Area (B, T, and U facilities, the Plutonium Uranium Extraction Facility and the Reduction Oxidation Plant) at the Hanford Site. The assessment made by the Canyon Task Team centered on the possibilities of removing the processing facilities, leaving all or part of the facilities in place and identifying alternative beneficial uses for the facilities. The team concluded that the technical approach for dispositioning any of the facilities could be bounded by the following seven alternatives:

Alternative 0:
No Action

Alternative 1:
Full Removal and Disposal

Alternative 2:
Decontaminate and Leave in Place

Alternative 3:
Entombment with Internal Waste Disposal

Alternative 4:
Entombment with Internal/External Waste Disposal

Alternative 5:
Close in-Place - Standing Structure

Alternative 6:
Close in-Place - Collapsed Structure

The Record of Decision for the 221-U Facility will generate regulatory and technical precedence for future disposition of the other four remaining processing facilities at Hanford and other such facilities across the DOE complex.

Current Reporting Period Activities:

Preparation of the survey plan for the structural assessments, including the ventilation tunnel was completed during a previous reporting period. The concrete coring unit, which consists of a Brokk 150N with concrete coring attachment, completed acceptance testing and has been used for obtaining concrete samples in the railroad tunnel. The concrete coring unit will be used to obtain samples to support the structural assessments and to determine whether potential contaminants have migrated beyond the confines of the process cells. Agreement has been reached with the regulators that cell coring will occur in process cells 5, 6, 26, and 36.

The process cell access work is now complete. All previously unopened cells have now been opened, video taped, and radiological surveys completed.

The 24-inch drain line characterization effort was completed in August 2000. The deployment was a complete success, with all 800 feet of the drainpipe inspected, and videotaped. A remote crawler and support equipment were procured, configured, and tested to support the deployment.

The raw data is now being analyzed. A report of the finding from the data will be published in one of the upcoming monthly reports.

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Highly Selective Nuclide Removal System—Accelerated Site Technology Deployment

Objective and Scope. In 1992, the last of the five U.S. Department of Energy production reactors at SRS was placed into shutdown mode, with no intention to restart.With this action, the site entered into an extensive deactivation and long-term surveillance and maintenance life-cycle phase of these facilities. The integrity of the aging facilities has become a concern in recent years. Large volumes of contaminated water exist at some of these facilities at SRS (for example, fuel storage and disassembly basins). Treatment of this water requires removal of the water from the basin and shipment to the F and H Area Effluent Treatment Facility (ETF). A technology that is cost-effective and safe is needed to process the basin waters on location and selectively remove radioactive materials without transporting the water to ETF. The technology must reduce targeted nuclides to near DOE release limits and condition the water for direct release. Efforts to address these concerns have been initiated under the current funding for reactor monitoring and are being incorporated into the overall facility deactivation, decontamination, and decommissioning planning strategy. With the uncertainty of the basin integrity over time, a technology that can remove radioactive contamination from the basin water while minimizing secondary waste generation is essential to the success of the deactivation of the DOE reactor basins. The SRS ASTD is deploying an innovative, highly effective water treatment system to remove selected radionuclides (both strontium and cesium) from millions of gallons of water. Overall, deactivation and decommissioning life-cycle costs are expected to be significantly lowered via deployment of the technology.

Status, Accomplishments, and Current Reporting Period Activities

See Highlights Section 1.0.

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Mobile Work Platform—Accelerated Site Technology Deployment

Objective and Scope. This ASTD project involves a partnership between the Fernald Environmental Management Project (FEMP) and Idaho National Environmental and Engineering Laboratory (INEEL) to purchase and deploy a Mobile Work Platform (MWP) at Fernald and the INEEL and potentially at other DOE Sites including Hanford, Rocky Flats and the Savannah River Site.

Five major complexes, Plants 7, 4, 1, Boiler, and 9, at the FEMP site have been successfully decontaminated and decommissioned (D&D) during the course of ongoing environmental restoration activities pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Major complexes, Plant 2, Plant 8, and the Pilot Plant, will undergo

D&D activities in FY 2001 and FY 2002. In addition to the FEMP facilities, the INEEL Test Area North - Building 616 has also been identified as a deployment location.

To address the sites' needs, Fernald and the INEEL will develop a common specification and then purchase a MWP that satisfies both sites' needs.

Status and Accomplishments. While the FEMP achieved cost and schedule improvements with each successive D&D project, D&D of the major projects was expensive and labor intensive. Of particular concern during past, present, and future D&D projects is the removal of "process" piping. Removal of process piping presents two concerns. The first is a personnel safety concern. The workers, impaired by several layers of personal protective clothing and a full-face respirator, have to handle power tools while working off the ground on ladders, scaffolding and/or man-lifts. The second concern is the close proximity, within inches, that the workers have to be to a radiation/contamination source (process piping). This concern has been formally documented at FEMP by the Site Technology Coordination Group (STCG), Need Number OH-F010, "Safe and Efficient Process Piping and Conduit Dismantlement." This is the highest priority of Fernald's documented D&D needs. Use of a MWP will remove the workers from the immediate industrial hazard and radiation/contamination zone, which will significantly increase the safety of the pipe/conduit removal process.

Current Reporting Period Activities:

Due largely to recent demolition and dismantlement productivity improvements at FEMP, the site has proposed a major scope change to this project, which has been communicated to the DDFA and is currently under evaluation. Results are forthcoming.

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Remote Size Reduction for Large Hot Cell Deactivation—Accelerated Site Technology Deployment

Objective and Scope. The 324 Building, located at the Hanford Site near Richland, Washington, is being deactivated to meet state and federal cleanup commitments. The 324 Building has several highly radioactive tanks, tank vaults, piping and large hot cells containing complex chemical processing equipment. To meet the cleanup commitments, there is a need to deploy more rapid and remote size-reduction, debris collection and removal, characterization and decontamination methods. Readily deployable deactivation methods that reduce worker exposure, secondary waste generation, costs, and risks are also needed. Deployment of a remote/robot work platform in the 324 B-Cell with full reach capabilities will significantly accelerate work tasks, eliminate the need for multiple, specialized tool design and procurement and reduce the overall program risks.

The Hanford Site ASTD project will fund the deployment of a robot work platform to support 324 B-Cell cleanup activities. Through this project, Hanford will procure and deploy a remote/robot work platform that is positioned with an overhead crane to perform deactivation activities. Following B-Cell cleanup, the work platform will be

deployable for other 324 and Hanford site cleanup missions.

Status and Accomplishments: The French firm Cyberneteix was awarded the contract for the remote/robotic platform that will be deployed at the 324 facility hot cells. The remote/robotic platform will help facilitate rapid remote size reduction, debris collection and removal, characterization and decontamination operations to enhance deactivation of the hot cell complex to meet state and federal cleanup requirements. Deployment of the new system will reduce worker exposure, secondary waste generation, cost, and risk. Current baseline operations use overhead cranes and mechanical manipulator systems.

Current Reporting Period Activities:

Fabrication of the Robot Work Platform System (RWPS) is nearing completion at Cybernetix in France. All subsystems (The mast, hydraulic power unit, control panels, work platform and articulated arm) are being assembled for integrated testing at the factory. After factory check out, Hanford personnel will participate in the Factory Acceptance Test (FAT) and accept the system for DOE. Initial deployment at Hanford will occur in July/August timeframe, after operators are trained in a non-radioactive "cold" high bay in the 306E building.

In addition, the contract with Cybernetix was modified requesting them to design and fabricate a special work stand which will allow the SAMM arm to perform deactivation activities below the floor level in places like the airlock pipe trench. This modification along with the original TOTEM mounted work platform will allow full range of work capabilities above and below the floor level.

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Surface Contamination Monitor—Accelerated Site Technology Deployment

Objective and Scope: The objective and scope of this Nevada Test Site (NTS) ASTD project is to deploy a Surface Contamination Monitor and Survey Information Management System (SCM/SIMS) from Shonka Research Associates (SRA). The SCM/SIMS will be deployed at the Test Cell C facility, which was used for testing nuclear rocket reactors. The facility has a large exterior concrete pad and interior floor spacing requiring survey. The SCM/SIMS will be used for the radiological characterization of concrete floors in order to expedite survey and closure at a reduced cost and risk. Use of SCM/SIMS is expected to be extremely beneficial in characterizing the Test Cell C facility, and is expected to be deployed at other NTS facilities including the Pluto facility.

Status and Accomplishments: Over 3700 square meters were surveyed using the SCM/SIMS. Surveying productivity was more than an order of magnitude greater for the SCM/SIMS, and the total cost was several times less than the baseline technology. Initial SCM/SIMS deployment at NTS was completed early in FY 2000. The NTS is discussing/negotiating the use (acceptance) of SCM/SIMS with Nevada regulators, as the new baseline for clearance surveys across the site. The DDFA will promote the successful NTS deployments of the SCM/SIMS throughout the DOE, to support additional deployments and gain commensurate cost savings.

Current Reporting Period Activities:

The final Cost and Performance Report documenting deployment of the SCM/SIMS at the Nevada Test Site was submitted to DOE-HQ for printing and distribution. In brief, use of the SCM/SIMS resulted in a 2- to 5-fold improvement in survey productivity rates, and a cost reduction of 13 percent to 57 percent compared to the baseline method for characterization.

This activity is 100 percent complete; all milestones have been accomplished and all deliverables have been received by the Focus Area. This project will no longer be reported.

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Oversize Transuranic (TRU) Waste Laser Cutting System—Accelerated Site Technology Deployment

The Oversize Transuranic Waste Laser Cutting equipment from GSI Lumonics is used in ASTD to diminish the size of TRU waste to fit into WIPP containers.

Objective and Scope: DOE Nevada has a need to size-reduce and characterize 58 oversized TRU-contaminated metal boxes (total volume of 270 cubic meters) prior to shipping them to WIPP. The contents of these boxes are contaminated gloveboxes (32), a metal cutting lathe, lengths of metal piping, lengths of angle iron, and various scrap metals. The Hanford material requiring size reduction includes a minimum of 150 glove-boxes (there are also ductwork and piping). At Rocky Flats, the laser cutting system will also be applied to contaminated gloveboxes (150).

Status and Accomplishments: The laser and chiller, and trailer were purchased, and were stored at the trailer installation vendor's site. The laser cutting equipment is expected to be installed at the LANL DVRS building site in November 2000, with full-scale operation beginning around April 2001.

Current Reporting Period Activities:

The installation of the laser, chiller, power supply, and cutting control station in the semi-trailer at the Physical Sciences Laboratory, New Mexico State University, was completed near the end of September 2000. The robotic arms, one to hold the cutting end-effector and the other to hold the object being cut, were ordered in August. In early FY 2001, the laser will be sent to GSI Lumonics to be sure that the laser and associated equipment is functional and performs as specified. Testing will include laser alignment checks, functional tests of the laser and robotic arms, and checks of safety interlocks. LANL and Fluor Hanford (FH) project team members will identify safety or operability issues at LANL and Hanford, and these will be addressed during this testing where practical. A final system acceptance test will then be performed. These LANL and FH team members will also provide testing oversight. The Lumonics testing is expected to be completed in early 2001 at which time the laser is anticipated to move to the Hanford site for pre-deployment cutting of uncontaminated large equipment, for operator training, and potential user evaluation.

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Personal Ice Cooling System (PICS)—Accelerated Site Technology Deployment

Objective and Scope: The objective of the Personal Ice Cooling System (PICS) (TECH ID 1898) is to control the heat stress of workers. This project is designed to deploy the PICS personal protective equipment to Fernald's workforce as well as to other DOE sites. Fernald will also implement administrative and educational programs designed to overcome cultural barriers and replace the existing baseline with the PICS. PICS is a self-contained core body temperature control

PICS is a self-contained core body temperature control system that uses ordinary ice as a coolant and circulates cool water through tubing that is incorporated into a durable and comfortable, full-body garment (pants, shirt, and hood).

system that uses ordinary ice as a coolant and circulates cool water through tubing that is incorporated into a durable and comfortable, full-body garment (pants, shirt, and hood). Water is frozen in bottles that are worn outside/inside of Anti-Cs in a sealed, insulated bag with a circulating pump attached to a support harness system. An adjustable-rate, battery-powered pump circulates the chilled water through the tubing in the suit. The adjustable pump allows the worker to control his temperature based upon his workload, unlike "ice vests" where the initial cooling is often extreme and uncomfortable. The ice bottle, pump, and suit make up only 12 pounds, a relatively small load. This effort provides the project team with nearly 100 PICS units as well as several central chillers and all required support equipment. The team will deploy various PICS systems (the three-piece [hood, shirt, and pants] suits and/or vests) to each of ten additional DOE sites by a team of Fernald labor-union personnel. This team will conduct proactive workshops on the PICS and its benefits to the workforces at ten other DOE sites (Nevada Test Site, Hanford, Oak Ridge, Paducah, Savannah River, Rocky Flats, Pantex, Los Alamos, Sandia, and Mound). It is envisioned that the educational workshops coupled with leaving "seed" PICS systems will create a demand for the PICS at the other DOE sites. This approach to widespread deployment using experienced workforce personnel is similar to the successful approach Fernald used to achieve widespread deployment of the oxy-gasoline torch. Not only will Fernald see the cost savings realized by using the PICS, but other DOE sites will as well.

Status and Accomplishments: As of September 2000, the Fernald team has deployed 104 PICS cool suit systems to 17 DOE sites through this ASTD project. Based on conservative estimates for their use across these 17 sites, the cost savings are estimated at around $805K per year. The results were derived using a conservative estimate of savings for the 17 DOE complex sites (Nevada Test Site, Hanford, Oak Ridge, Paducah, Savannah River Site, Sandia, Los Alamos, Pantex, Rocky Flats, Mound, Fernald, Lawrence Livermore National Laboratory, Carlsbad, Portsmouth, Ashtabula, West Valley, and Argonne National Laboratory East).

Current Reporting Period Activities:

During this current period, the project deployed the PICS cool suit system at West Valley, ANL-E, and Center to Protect Workers Rights (CPWR) in Washington, DC. CPWR will include the PICS cool suits in development, conduct, and performance of training sessions held at 17 locations nationwide. These activities complete this project. A final report will be prepared documenting all deployment activities for the project.

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Integrated Decontamination & Decommissioning—Accelerated Site Technology Deployment

Objective and Scope: The overall objective of the Integrated Decontamination and Decommissioning (ID&D) ASTD project is to increase the use of innovative/improved but proven technologies on a large scale in the D&D of facilities in the DOE weapons complex. The reason for increasing the use of these innovative/improved technologies is that each has demonstrated improvements over current baseline methods in cost, schedule, waste generation, radiation exposure, or safety. Increased use on a large scale will be accomplished by doing actual D&D projects with the selected innovative/improved technologies, thereby increasing user familiarity and experience with them and adding them to the array of tools available for D&D projects. The technologies added to the D&D toolbox

have all been proven on a smaller scale, either through demonstration in the DDFA's LSDDPs or through commercial use, but they have not been used to decontaminate and decommission facilities across the DOE complex. After completing the ID&D ASTD project, the DOE expects to see increased use of these technologies that will result in ongoing cost savings at the INEEL, FEMP, Argonne National Laboratory-East (ANL-E), and other sites in the DOE complex. The ID&D ASTD project will provide for implementation and deployment of a suite of 12 D&D technologies. These technologies will be deployed at over 20 deployment sites (facilities) at the INEEL, FEMP, and ANL-E. The anticipated technologies included: oxy-gasoline torch; track-mounted shear; hand-held shear; GammaCam; BROKK 250 demolition robot; Decontamination, Decommissioning, and Remediation Optimal Planning System (DDROPS); soft-sided containers; snap-together scaffolding; concrete crusher; Personal Ice Cooling System (PICS); lead paint analyzer; and alloy analyzer.

Status and Accomplishments: During the project, the FEMP project team performed D&D on nine facilities 3F, 3G, 8F, 22A, 24B, 38A, 38B, 39C, and 45B and dismantled and demolished them utilizing the oxy-gasoline torch (Tech ID 1847), hand-held shear (TECH ID 2304), and track-mounted shear-crusher (Tech ID 2303) technologies. At the INEEL, the following technologies were deployed in some 11 facilities to date: Oxy-gasoline Torch (Tech ID 1847); GammaCam™ Radiation Imaging System (Tech ID 1840); Remote Control Concrete Demolition System (Tech ID 2100); Decontamination, Decommissioning and Remediation Optimal Positioning System (DDROPS) (Tech ID 2322);Soft-Sided Waste Containers (Tech ID 2240), EXCEL Automatic Locking Scaffold (Tech ID 2320), Personal Ice Cooling System (PICS, Tech ID 1898), Lead Paint Analyzer (Tech ID 2317), PCB Analyzer (Tech ID 2398), Paint Scaler (Tech ID 2952), En-Vac Robotic Wall Scabbler (Tech ID 2321), Surveillance and Measurement System (Tech ID 2977), and Global Positioning Radiometric Scanner System (Tech ID 2954). During the project, the Argonne-East team deployed a Remote Control Concrete Demolition System for the demolition of the CP-5 reactor bioshield; they also used the oxy-gasoline torch for cutting reinforcing bars in the concrete and other metals in the reactor service area.

Current Reporting Period Activities:

During the current period, the Global Positioning Radiometric Scanner (GPRS) system was deployed at INEEL. The GPRS system makes characterization faster, less expensive, and more accurate. The technology includes a radiological detection system, portable computer, differential global positioning system, and four-wheel drive vehicle. Detectors are mounted three feet high on the front of the vehicle. Geosoft, a software program, graphically represents data to identify radioactive contamination. Using the GPRS system increases the number of data points surveyed, resulting in more accurate and reproducible data. The combination of real-time analysis and the four-wheel drive system reduces the number of surveying labor hours by 77 percent. In other deployments, the Surveillance and Measurement System (SAMS) was also deployed. The SAMS provides isotopic identification in a hand-held radiation detector. Since the beginning of June, it has been used to characterize 357 samples, and less than half of these have required further lab analysis.

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Release of Concrete for Recycle from Decontamination and Decommissioning Projects—Accelerated Site Technology Deployment

Objective and Scope: While most of the concrete waste generated during D&D activities is not contaminated, some portions are contaminated with radioactive or chemical

The concrete crusher being loaded with concrete debris.

constituents. Because of the difficulties and uncertainties associated with the unrestricted release of concrete, much of the uncontaminated concrete is treated as though it were contaminated and is disposed as low-level radioactive waste. Even concrete that is shown to be uncontaminated is disposed of in either a sanitary landfill, or is used as backfill. Disposal at a radioactive or sanitary waste site can be costly and eliminates the opportunity to economically recycle or reuse the concrete.

The INEEL ASTD project, in collaboration with ANL-E, will develop and test a protocol for the free release of concrete. The protocol, to be developed by the ANL-E, will follow the ten basic steps for free release outlined in DOE Order 5400.5, and will be modeled after the protocol for the free release of scrap metal previously developed by the ANL-E. In short, the protocol will be a decision tree that takes into account factors such as the type and level of contamination, volume and type of concrete, stakeholder and public approval, and the cost of decontamination. Based on this information, the protocol will outline possible disposition alternatives for the concrete and their relative costs. The protocol will be applicable across the DOE complex. Once the protocol is written, it will be applied to a test case at the INEEL to assist with planning D&D of a facility. The protocols will then be shared with others within the DOE complex so that it can then be applied on a complex-wide basis to reduce the cost of D&D operations involving concrete removal by allowing for re-use of concrete that meets EPA regulations and DOE orders.

Although many relatively small facilities have previously been decommissioned at the INEEL, many large facilities await decommissioning. Facilities such as the Engineering Test Reactor (ETR), Materials Test Reactor (MTR), Power Burst Facility (PBF), and a variety of waste handling and laboratory facilities will be decommissioned over the next several years. Each of these facilities contains massive amounts of concrete, which represents tremendous savings potential if it can be re-used. The amount of contaminated concrete at the INEEL is estimated to be as low as 278,000 ft^3 and as high as 354,000 ft3, while the non-contaminated concrete (including that in the landfill) is estimate at 7.7 million ft^3.

Status and Accomplishments: The preliminary draft of the Protocol for the re-use of Concrete was received from the ANL-E on February 29 and reviewed by the INEEL team. The Central Facilities Area (CFA) Sewage Treatment Plant was chosen as a test case for the new protocol. Information to support the protocol was sent to the ANL-E, including INEEL procedures and data on the CFA Sewage Treatment Plant concrete volumes, contaminants, facility and process descriptions and disposition methods chosen. In addition, a summary of common concrete cleaning methods with their capital and operational costs and throughput rates was provided.

Current Reporting Period Activities:

The following documents were completed and final preparations for their distribution were initiated during the current reporting period:

- "*Protocol for Development of Authorized Release Limits for Concrete at U.S. Department of Energy Sites*," ANL/EAD/TM-92 (July 2000)
- "*Concrete Release Protocol Case Studies for Decommissioning Work at Idaho National Engineering and Environmental Laboratory*," ANL/EAD/TM-94 (September 2000)

Combined, these two reports provide both a method and an illustrative example for performing detailed analysis of the dose and cost impacts for various concrete disposition alternatives during D&D of a facility. The approach and the example presented are intended for use as a streamlined decision tool for managing the disposition of concrete in accordance with the Department's guidance in, "*Draft Handbook for Controlling Release for Reuse or Recycle of Property Containing Residual Radioactive Materials*" and under the current Order 5400.5. The reports evaluate a wide range of disposition options under the 10-step process stipulated by the Handbook.

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The Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project—Accelerated Site Technology Deployment

Objective and Scope: The BGRR was a graphite-moderated and -reflected, air-cooled, thermal neutron research reactor that operated from 1950 to 1968. In 1997, following safe shutdown during the 1970s and 1980s, a site-wide review found radioactive water in the BGRR underground air-cooling ducts. Subsequently, it was determined that a comprehensive investigation of the environmental vulnerabilities and overall facility condition should be conducted. The first phase of this investigation involves characterization to support D&D planning of the BGRR facility including; the reactor building (701), the reactor pile (702), the fan house (704), the instrument house (708) and the canal house and outdoor pad (709). Characterization will also be needed to support waste disposal operations during decommissioning operations and to verify regulatory compliance following D&D operations.

The DDFA is supporting the BGRR Decommissioning Project through two separately funded Accelerated Site Technology Deployment (ASTD) projects. The first of these two projects involves the deployment of innovative in situ characterization techniques and implementation of the guidelines contained in the MultiAgency Radiation Survey and Site Investigation Manual (MARSSIM) for characterization of the reactor pile and above-grade ducts. The second ASTD project, funded in late FY 2000 and supported by the Subsurface Contaminants Focus Area, supports efforts to characterize soils and below-grade concrete ducts using innovative characterization and sampling techniques coupled with 3D modeling capabilities.

Current Reporting Period Activities:

Both in situ and ex situ samples were analyzed for the Graphite Reactor Pile characterization using the in situ Object Counting System (Tech ID 2098). A total of eight in situ measurements and numerous ex situ samples of graphite and other internal components extracted from the Pile were analyzed using ISOCS. Characterization of the Pile was completed, although additional samples generated during D&D will be analyzed as needed. In July 2000, the first section of the BGRR aboveground ducts was removed from the top of the Fan House. The first section removed weighed about 167,800 pounds, and is the largest of the nine sections that will be removed. Segmentation and packaging of the ducts has commenced. ISOCS was used for ex situ characterization of liquid and solid samples generated during removal of the above-grade ducts.

In September, Brookhaven received initial funding for the Smart 3D Characterization activities scheduled to occur through-out FY 2001. Preliminary activities to gain access and characterize the below grade canals was initiated. Numerous asphalt and concrete bore holes were completed for deploying the Geo-probe within the canal and water treatment house.

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Rocky Flats D&D Initiative

Objective and Scope: Rocky Flats is on an aggressive, accelerated schedule to achieve cleanup and "closure" of the Site by the end of 2006. The baseline Plan for the Rocky Flats Closure Project involves dispositioning over 900 contaminated gloveboxes, more than 450 production process tanks, thousands of feet of ventilation system piping, and miles of production process piping. In order to accomplish this challenging goal, Rocky Flats must apply new and improved technologies and methods in the areas of characterization, decontamination, size reduction, and waste handling and packaging. In fact, continued application of new and innovative technologies is a key assumption written into the baseline Plan to close Rocky Flats successfully. DDFA is supporting this aggressive schedule through the deployment of proven, commercially available technologies and innovative systems that require only minimal modifications to be used at the site.

Current Reporting Period Activities:

A significant cost in the D&D of buildings at RFETS is the size reduction and packaging of plutonium-contaminated gloveboxes, tanks, and other equipment. DDFA is supporting three new ASTD projects to facilitate the safe and cost-effective disposition of these systems.

The first new ASTD project supports an in situ size reduction system (ISSRS), which will provide a remote and automated approach for size reduction and removal of large and/or highly-radioactive equipment that cannot be moved to a central size reduction facility. The ISSRS will use enhanced cutting technology and tooling to accommodate size reduction of a wide range of metal waste. The system will include a graphical user interface designed to assist with operation and maintenance of the system. The system will also generate a waste stream that meets low-level and transuranic waste acceptance criteria for approved offsite disposal once final non-destructive assays are complete.

The second new ASTD project supports the implementation of proven decontamination technologies to reduce the level of surface contamination from TRU-contaminated to low-level contamination. Deployment of safe and efficient decontamination techniques will leave the equipment in a condition suitable for shipping as surface contaminated objects and minimize or eliminate the need for costly equipment size reduction required for WIPP waste acceptance criteria. Technologies being considered include carbon dioxide (CO2) pellet blasting, sponge abrasive blasting, acid etching, mild acid precipitation, and mild acid etching using tetravalent cesium dissolved in nitric acid.

The final new ASTD project supports deployment of a broad array of state-of-the-art instrumentation to support personnel monitoring, equipment surveying, and waste inspection. Improved instrumentation is needed that is more cost effective, but the ability to accelerate D&D schedules through improved productivity and to maximize personal safety are the primary considerations.

In addition to these new ASTD projects funded in FY 2000, the DDFA also supports other deployment activities at Rocky Flats. The Remote Operated Size Reduction System (ROSRS), funded as an ASTD project in FY 1999, was demonstrated at the PaR Systems facility in Minneapolis, Minnesota, in July 2000. ROSRS is a remotely operated system designed to cut apart and package small plutonium contaminated gloveboxes that can be removed from their current location in the Rocky Flats facilities. The purpose of the demonstration was to show if the telescoping plasma arc torch, in conjunction with a grab on a jointed arm, could effectively dismantle a glovebox. In anticipation of its delivery to the Rocky Flats site, a second demonstration of the integrated system will be conducted at the PaR facility in November 2000.

Another development during the current reporting period was the delivery of the Standard Waste Box (SWB) Counter from

Los Alamos National Laboratory to Rocky Flats. The SWB, originally funded via an FY 1998 ASTD project, is a self-contained, trailer-mounted system that can easily be transported around the site or between DOE sites. The unit uses High-Energy Neutron Counting (HENC) technology. This is a passive neutron coincidence detection assay technology similar to that successfully used for WIPP-certified drum counters. Plans are to collect assay data until January 2001, when WIPP will then audit the system. After notification of "passing" the WIPP audit, Rocky Flats will deploy the system beginning in the late second quarter or early third quarter of FY 2001.

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Diamond Wire Saw Demolition and Size Reduction of a Reactor Bioshield—Accelerated Site Technology Deployment

Objective and Scope: The Columbus Environmental Management Project was awarded an ASTD project to deploy a diamond wire saw system to size reduce an activated bioshield and associated structures in a decommissioned research reactor at Battelle's West Jefferson site in Columbus, Ohio. The bioshield is made of high-density concrete approximately eight feet thick with an extensive internal latticework of carbon steel reinforcement bars. This technology was used successfully in decommissioning projects at Fort St. Vrain and Shoreham Nuclear Power Plants, but has seen little application within DOE's decommissioning projects. The estimated cost to size reduce the Building JN-3 bioshield at West Jefferson is $780,000 using the diamond wire saw compared to an estimated cost to dismantle the bioshield with the baseline technology of heavy jackhammers at $1,051,000. Thus, size reduction

Diamond Wire Cutter

using the diamond wire saw represents a cost saving of about 25 percent compared to the baseline approach. Subsequent deployments of the diamond wire saw are planned for Mound and West Valley.

Current Reporting Period Activities:
No significant activities to report this quarter.

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Reducing, Reusing, and Recycling Concrete and Segmenting Plate Steel and Tanks Utilizing a Universal Demolition Processor—Accelerated Site Technology Deployment

Objective and Scope: As decontamination and decommissioning work at Fernald progresses from above-grade facilities to

at-grade and below-grade facilities, there will be a bona fide need for new technologies to process concrete. Fernald can realize significant cost savings by reprocessing and reusing a portion of the site's concrete. There is a defined need for aggregate to build and strengthen the site's transportation infrastructure in and around the On-Site Disposal Facility (OSDF). Project personnel in the Soils and Water Division have an estimated need for up to 15,000 cubic yards of aggregate per year, for the next six years. Not recycling the site's concrete means that tons of aggregate will have to be trucked in from offsite and subsequently disposed in the OSDF. Reprocessing a portion of the concrete saves the costs associated with the purchase of virgin aggregate and its subsequent disposal cost. The site can also realize increases in safety, efficiency, and schedule by utilizing the plate shear capability of the universal processor. Fernald has numerous large, heavy steel tanks including two water towers and numerous tanks made of stainless steel.

To address the site's needs, EM's Office of Science and Technology (OST) has partnered with FEMP in an ASTD project with OST providing $800,000 for this deployment. Through the activities in this project, innovative technologies will be deployed to accelerate demolition/recycling of construction materials for road construction, and for segmenting large, hard to cut, plate steel and tanks. Overall, decommissioning life-cycle costs are expected to be significantly lowered via the deployment of these technologies.

Current Reporting Period Activities:

FEMP's proposal to deploy the Universal Demolition Processor was selected for award in Spring 2000. The project was fully funded at the $800k level in the May Financial Plan. The steps necessary to successfully implement and deploy the universal processor are as follows:

- Approved life cycle TTP (October 2000)
- Award contract for the Universal Demolition Processor (November 2000)
- Copy of contractor's monthly report when D&D project starts. (Not available until D&D starts in March 2001)
- DDFA Mid-Year Review Briefing package, and presentation, if requested (April 2001)
- Videotape and still photographs of equipment (UDP) in use. (May 2001)
- Inclusion of the UDP to Fernald's Technology Programs' webpage. Periodic updates of the UDP will be made, as appropriate when new information/data is available. (starting May 2001)
- One or more "before" and one "after" deployment press releases/short "announcement" type of article (e.g. Fernald newsletter, industry newsletter or trade journal, etc.). (June 2001)
- Draft Cost and Performance report to DDFA for review. (July 2001)
- Complete Deployment of the Universal Demolition Processor (September 2001)
- Post deployment Factsheet (September 2001)
- One or more conference papers and accompanying presentation of the UDP ASTD project (said conference could include a technical information exchange). (September 2001)
- Display board material (4x8 display) (September 2001)
- A detailed cost data package that validates and addresses the proposal and cost savings will be submitted DDFA. (September 2001)
- Final Cost and Performance report (camera-ready report to DDFA) (September 2001)

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Improved Measurement and Monitoring Systems—Accelerated Site Technology Deployment

Objective and Scope: The Fernald Environmental Management Project (FEMP) is a 1,050-acre DOE Closure Site currently undergoing decommissioning and environmental restoration. As environmental cleanup work at the FEMP accelerates towards closure and long-term stewardship, there is an increasing need for new, innovative technologies to perform real-time physiological monitoring, land surveying, and wireless radon monitoring. In the process of deactivating and decommissioning DOE facilities, individual laborers sometimes need to work in/near radiological and hazardous locations, and in situations that lead to extreme physical conditions. At FEMP, these types of extreme conditions will likely occur in the upcoming FEMP Silos project and in other restoration projects across the site. Technologies are needed that reduce workers' risk during engineering, construction, and environmental restoration operations. To minimize these risks, three new technologies have been identified for deployment at FEMP. Collectively, these technologies will provide for the monitoring of worker vital signs, improved land surveying, and the remote transmission of radon monitoring data.

Current Reporting Period Activities:

The technologies described herein were selected for ASTD program funding in Spring 2000 and funds were provided to FEMP in May 2000. These funds ($327K) will be used to champion the initial cost of the equipment and systems as well as the costs to integrate the technologies into FEMP's operations. The Remote Prismless Total Station (RTPS) purchase order was issued in September 2000 and is expected to arrive on site by the end of November 2000. Training and the initial deployment are planned to be completed by the end of December 2000. A request for proposal for the wireless radon monitoring system was issued September 28, 2000. Vendor selection is to be completed by the end of December 2000, with installation of the system complete by May 2001. The system will then remain operational for the balance of FY 2001 and beyond.

A vendor for the Real Time Physiological Monitoring System (RTPMS) has been contacted and a site visit/briefing is being planned for November 2000. Depending on specific job requirements and work conditions however, the RTPMS may not be deployed until May 2001. Technology communication products, e.g., fact sheets, will be developed throughout the life of the project and the success of each technology will be widely reported in a variety of formats.

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Intrusive and Non-Intrusive Characterization through Concrete Walls and Floors—Accelerated Site Technology Deployment

Objective and Scope: In mid-FY 2000, the Miamisburg Environmental Management Project was awarded an ASTD project to ascertain the nature and extent of contamination in an area under SW Building known as the "Old Cave." The Old Cave is actually the entombed remains of a 1950's hot cell, which must be removed before the City of Miamisburg, Ohio, will accept ownership of the Mound site. In SW Building, the Old Cave is located under an area designated SW-19. Because of lack of knowledge of what all is in the Old Cave area, ultra conservative estimates of the amounts of Ac-227 and Ra-226 have been made which required the Old Cave to be classified as a Category 2 Nuclear Facility. It is considered highly unlikely that that much radioactive material resides in the Old Cave. The approach is to characterize SW-19, the

surroundings, and the entombment. In Phase I– Non-Invasive Investigations, they plan to characterize the entombment using ground penetrating radar and time-domain electromagnetics, gamma spectrometry, drain exploration, and radon monitoring. In Phase II– Invasive Investigations, they plan to perform these investigations with respect to the entombment via diamond core drilling and/or Geoprobe with a real-time position location determination device. Once better defined radioactivity levels are determined, and a final design decision to the Baseline Plan is made, several enhancements that shorten the schedule and reduce costs may result. A baseline recovery of only one-week would recoup the entire ASTD investment. If the baseline acceleration is greater than the one week, the return on investment will increase proportionally as additional weeks/months are saved from the baseline. Based on the Value Engineering study, it is conservatively estimated that four months can easily be recovered when compared to the present technical approach.

Current Reporting Period Activities: The initial draft Process Summary Report for the Phase I - Non-Intrusive Characterization has been prepared. From the report, a final design decision will be forthcoming in how to proceed with the removal of the Old Cave entombment area. In the interim, the project team is moving forward in investigating the feasibility of grouting the entombment area. Because they believe, if it can be done safely and within a reasonable time frame, that properly grouting the entombment provides additional safety and possible cost advantages. Hence, they have initiated a technology search on the grouting process and the grouting materials, including a grouting subject matter expert. They want to understand the processes shortcomings, as well as the technical advantages and successes before they make any design commitments. Therefore, they are also seeking an engineering firm that can conduct a viable grouting feasibility study.

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Deactivation & Decommissioning (D&D) Consortium

Objective and Scope: In December 1997, DOE signed a Memorandum of Understanding (MOU) with the Electric Power Research Institute (EPRI) and several nuclear utilities to jointly develop and deploy new D&D technologies. DOE's objective is to expand the reach of benefits of the "leading-edge" technologies being deployed within the DOE nuclear complex. The MOU Consortium established a charter in early 1998 and identified challenging technological areas common to both DOE and the commercial industry. Both DOE and commercial sites will be used for these demonstrations and deployments.

DOE and EPRI are collaborating to conduct quarterly workshops at various nuclear plants around the country, each focusing on a particular decommissioning area. DOE and the utilities present the most recent, innovative technologies to improve productivity and worker safety while reducing cost. The workshops will solicit feedback from hands-on plant managers and field workers. Topics covered to date address low-level waste disposal, concrete decontamination, imbedded pipe decontamination, and site characterization.

Status and Accomplishments: The first technology demonstration resulting from the DOE/EPRI/Utility Consortium was completed at the Rancho Seco Nuclear Power Plant.

The first technology demonstration involved the concrete shaving technology developed by Marcrist Industries, Ltd. Two separate pieces of equipment were demonstrated. Both used a diamond-impregnated shaving drum as the cutting tool for removal of the concrete surface. Generated dust was collected by a vacuum system and deposited in a waste drum.

The first piece of equipment was a self-propelled, electric powered floor shaver. It was demonstrated on clean and radioactively contaminated floor areas in the reactor turbine building. Several parameters were recorded as part of the demonstration and the technology was well accepted by the operating staff.

The second piece was a hydraulically powered wall-shaving unit. For purposes of the demonstration, the unit was mounted on a forklift.

Current Reporting Period Activities:

A meeting with the Decommissioning Manager at Rancho Seco took place mid-October. Rancho Seco is supportive of the MOU and is interested in continuing with demonstrations that integrate with their current decommissioning efforts. Additionally, Rancho Seco re-emphasized that the Marcrist Shaver demonstration went well. Future technology demonstrations should not have a negative impact in the decommissioning schedule for the site nor add appreciable cost to the decommissioning of the facility. The Rancho Seco staff is interested in new technologies that have the potential to save real cost. It was indicated that the D&D Focus Area would be glad to share technologies with the Sacramento Municipal Utility District (SMUD), and assist with coordination of demonstrations that make sense.

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Florida International University

Objective and Scope: The Hemispheric Center for Environmental Technology (HCET) at Florida International University, is working on several D&D related research projects under a grant awarded by the DOE Office of Science and Technology. These FY 2000 projects include:

- Deactivation and Decommissioning Technology Assessment Program
- Integrated Vertical and Overhead Decontamination System
- In Situ Pipe Decontamination System
- Technology Information Management and Dissemination
- Size Distribution and Rate of Production of Smoke and Particulate Matter During the Cutting of Metals
- Mercury Contaminated Material Decontamination Methods Investigation and Assessment
- PCB Contaminated Coatings Treatment System Development
- Technical Assistance and Response Development
- Online Measurement of the Process of Decontamination
- Remote Surveillance of Facilities Awaiting Deactivation and Decommissioning
- Volumetric Lead Assay

Current Reporting Period Activities:

- Review comments were received from FRAMATONE regarding FIU-HCET's technology evaluation package sent to them in early August 2000.
- RedZone Robotics demonstrated their Houdini/Predator robotic arm with two cutting tools, high-pressure water (HPW) cutting and electric shears, at FIU-HCET on August 21–24, 2000. This demonstration showed the potential capabilities of the technology and is being considered Phase I of a more comprehensive assessment that will be completed in FY 2001. The Phase I results will be sent to the vendor for review in approximately 3 weeks, and the Technology Evaluation Summary Sheet will be published in the October Monthly Progress Report.
- Rad Elec Inc. demonstrated their E-Perm® Alpha Surface Contamination Monitor at FIU-HCET on August 14-16, 2000. Certain technical problems with the vendor's data have caused delays in its availability to FIU-HCET.
- TechXtract® and Hydrogen Peroxide chemical decontamination technologies were demonstrated at Princeton Plasma Physics Laboratory (PPPL) on September 5-7, 2000 on the following two metal surfaces: faraday shields and flanges. These items were contaminated with tritium. At PPPL's request, the FIU-HCET TAP sent an evaluator to observe and collect technical data. The data collected is being

processed. Additional radiological survey data is expected from PPPL in mid September 2000, to complete technology assessment package.

- TMR Associates Inc. and ThermoRetec demonstrated their RadTrax/LARADS Radiological Mapping System at FIU-HCET on September 11-14, 2000. The system displayed its ability to conduct a survey for alpha, beta, and gamma radiation on walls and ceilings. It will take the vendors 1-2 weeks to compile their survey results, i.e., maps indicating location of the sources and their activity levels. FIU-HCET's technology evaluation report will be written upon receipt of these survey maps.
- France Wright, Property Administrator, NETL, on September 14, 2000 approved the final disposal of one glove box and one annular tank segmented during FRAMATOME's technology demonstrations. An additional form, "Property Certification-Grant," needs to be completed before a Relief of Accountability letter will be issued. Final disposal authorization is expected by the end of this month.

Status and Accomplishments: Under this project and earlier technology assessment projects funded from other sources, FIU-HCET has assessed over 80 baseline and innovative technologies for D&D application under standardized, non-nuclear testing conditions. Many of the technologies identified for demonstration at FIU-HCET are selected to address the needs identified in the EM-50 Needs Management System (*http//EM-Needs.em.doe.gov/Home/*). As a result of these assessments, directly comparable performance data related to operations and maintenance, primary and secondary waste generation, and health and safety have been compiled. These data have been valuable in assessing whether a technology meets the screening criteria for those DDFA LSDDP's where these technologies are being considered, as well as assisting EM-30 project managers in making decisions on the deployment of innovative technologies. Technology assessment data are managed using a Microsoft Windows-based multimedia information system.

To date in FY 2000, twenty-one (21) demonstrations have been completed.

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AEA Technology DDFA Projects

The DOE engaged AEA Technology, through an International Agreement, to bring a UK perspective to U.S. decommissioning activities within the DOE-complex. AEA's contributions are broad in nature and include planning as well as specific technology contributions.

Demonstration and Deployment of Soft Media Decontamination Techniques for Various Applications at the Savannah River Site:

Introduction: DOE has a large inventory of contaminated lead currently stored throughout the complex with more being added as DOE and its contractors decontaminate and decommission facilities. For example, SRS currently has 200 to 300 tons of stored lead that must be decontaminated in an efficient, cost-effective manner. ANL and INEEL also have a similar problem and have expressed a need to identify a cost-effective and reliable technology with a proven track record to de-contaminate lead prior to final disposal. AEA has extensive experience in designing, building and operating pliant media blast systems in high-radiation environments, particularly in the commercial nuclear sector.

Although pliant media decontamination is not a new technology it has not been extensively demonstrated or deployed in the DOE complex for these applications. In this project, AEA will use its commercial deployment experience to perform a hot demonstration of lead brick decontamination at SRS. Demonstrating the effectiveness of the sponge blasting system is expected to lead to future deployments throughout the complex. SRS has also expressed a need for a decontamination technology for contaminated tank riser

plugs and pump transport vessels. In addition to performing the hot decontamination demonstration on contaminated lead bricks, AEA will demonstrate the effectiveness of the pliant media blast system on a contaminated tank riser plug. During the operation phase of these demonstrations, AEA will train Savannah River staff on proper procedures for decontaminating these components using a sponge blasting system.

Current Reporting Period Activities: AEA demonstrated a soft pliant decontamination system for pipe and vessel interiors (Phase II efforts). The system performed as expected. AEA will now finalize their trials at Pittsburgh and then ship the system to the Savannah River Site for field demonstration and follow on deployments.

Demonstration and Deployment of a Passive Ventilation Device for D&D Activities at the Savannah River Site.

Ventilation control has classically been conducted using a pressure sensor, controller, valve actuator, and mechanical air-regulating valve to vary the flow of air and the depression in a system. Should the dynamics of the system under control vary, there is a finite time for the mechanical system to adjust while the signal from the pressure sensor travels to the controller as it opens or closes the mechanical valve to regulate the flow. The system is always lagging behind what is happening in the unit under control, and under certain conditions this can be detrimental to operations and/or hazardous to workers.

To overcome this situation in the UK, AEA developed a non-mechanical, part passive ventilation valve that responds instantaneously to the behavior of the system. This device, known as a Vortex Amplifier or VXA, has no moving parts and is maintenance free. It is able to react instantaneously to pressure variations in a system, and is therefore inherently more reliable and more efficient than conventional pressure equalizing systems. The scope of this PTP is to design, fabricate, and demonstrate a vortex amplifier for application at the SRS, offering a reliable, proven alternative with a better track record as compared to conventional mechanical systems.

Current Reporting Period Activities: The cold demonstration has been completed. Due to a delay, the final report is expected in the first quarter FY 2001.

Inspection, Sampling, and Remediation Options for Tank 105 in the HLW Vault in Building 324 at Hanford:

Introduction: To date, the DOE complex has primarily focused on closing large radioactive tanks and decontaminating and decommissioning smaller, low-level radioactive tanks at the various sites. In the coming years, several high-profile projects that involve highly radioactive waste tanks will need to be inspected, characterized, emptied and then dismantled, will commence. Due to the significant radiation dose and costs associated with these activities, an innovative, integrated approach to these activities is needed, which will deliver significant benefits in terms of increased safety, reduced costs, and shortened schedules.

As part of the overall decommissioning plan at the Hanford site, it is planned to close Building 324. One of the major projects involved in closing this building is the removal and disposal of four tanks in the high-level waste vault located beneath the hot cells in the building. These tanks, T104, T105, T106, and T107 are of the classic "Idaho" design and have limited access with all pipes having fully welded connections. Preparatory work needed for the removal of the tanks would include removal of piping and ductwork connections.

The purpose of this project is to conduct a feasibility study to examine several key aspects of the preparatory work leading to the temporary use and eventual D&D and removal of Tank 105. The principal stages of this process are envisioned to be:

- Inspection- deployment of a visual/imaging system into the tank to view the internals
- Radiation monitoring- to get an accurate radiation measurement
- Sampling-retrieval and analysis of a sample of waste to determine composition
- Decontamination- removal of the tank waste contents

Current Reporting Period Activities: The mock-up of the Tank 105 access/characterization/sampling/cleanout system

was demonstrated. Visuals were taken during the demonstration and these will be posted on the DDFA website. Negotiations are underway to design, fabricate, and test a system in FY 2001, which may be deployed in a hot environment.

Raschig Rings at RFETS:

Introduction: The Rocky Flats Environmental Technology Site (RFETS) in Colorado contains nine major plutonium process buildings as well as 60 or more uranium and radioactive waste storage buildings. All of the buildings are slotted for eventual demolition as stated in the site closure plan. Aggressive projects are underway to decommission the facilities at the site in time to meet the 2006 milestone.

Four of the buildings used directly in the plutonium production process house storage tanks with an inventory of raschig rings and sludge, which are used to control criticality. The raschig rings and sludge are required to be removed from the tanks as part of the deactivation activities taking place. The current method used to decommission tanks containing raschig rings requires building an enclosure around the tank and manually opening the tank. The raschig rings are then removed by shoveling or raking the rings into a separate container. These procedures expose workers to high levels of risk and result in high levels of airborne contaminants. Currently, the site is considering an alternative using fixative coatings to reduce the amount of airborne contamination. A system capable of retrieving the sludge and managing the criticality has yet to be identified.

Site need DD07 entitled "Improved Disposition of Raschig Rings" calls for a more robust method of raschig ring and sludge recovery.

The project proposes to create a conceptual design to remove the raschig rings and sludge from the tanks during deactivation activities. The design will consider techniques to mitigate the worker exposure risks. This is a major concern of the current system.

Current Reporting Period Activities:

AEA modified the Project Technical Plan (PTP) concerning the removal of the rings and sludge from tanks at Rocky Flats, per the DDFA's review. The program manager approved the PTP, and AEA has initiated task activities.

Contribution to the Development of an Options Study to Decontaminate Exhaust Ducting in Building 324 at Hanford:

Introduction: DOE has accelerated the Decommissioning and Dismantlement Schedule of the facilities in the 300 Area at the Hanford Reservation site in Richland, Washington. As part of the overall decommissioning plan at the Hanford site, it is planned to deactivate Building 324. One of the major projects involved in deactivating this building is the decontamination of the exhaust ductwork from the Radiochemical Engineering Cells (REC). To achieve this task, project managers will evaluate the most effective technologies and processes in terms of worker safety, cost effectiveness, track record, and schedule acceleration.

AEA will assist the Building 324 project representatives in developing an Options Study to characterize and decontaminate the ductwork in the facility with particular interest on the B Cell exhaust duct. The Options Study will identify suitable alternatives to achieve the project goals, which could be demonstrated as part of future scopes of work to determine the most beneficial program for DOE. AEA Technology representatives will review technologies and processes which have been deployed in other nuclear facilities in Europe and the United States for characterizing and decontaminated ductwork.

Current Reporting Period Activities:

The final options study report is expected in the first quarter of FY 2001.

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2.2 Facility Characterization

Portable X-Ray K-Edge Heavy Metal Detector

Objective and Scope: Ames Laboratory and Iowa State University's Center of Nondestructive Evaluation are developing an improved nondestructive assay (NDA) technique for detecting and quantifying uranium, plutonium and other heavy metals. The work is focused on situations where these materials are located inside sealed containers or processing equipment. The approach this technology uses is based on observing the K-edge absorption transition in x-ray transmission measurements. This technique is being developed to maximize the sensitivity for detecting heavy metals while minimizing the measurement time.

A project study showed that the K-edge heavy-metal detection technique would be beneficial for many D&D projects, especially those involving gaseous diffusion plants. Its use could have the biggest impact in inspecting the vast amount of piping in the plants. This inspection could be done in situ to allow monitoring of chemical flushing. The high sensitivity of the technique can be used to minimize the danger of contamination to workers and equipment during disassembly operations, resulting in savings of time and money in addition to reducing generation of waste.

Status and Accomplishments: During the first year of the project, FY 1994, the sensitivity of the technique was determined through modeling and laboratory demonstrations, ending with a design of a portable system. In FY 1995 and FY 1996, a prototype portable K-edge, heavy-metal detector was assembled and tested in the laboratory. This system consisted of a high-flux x-ray generator, a collimator for minimizing the local radiation hazard and providing the requisite beam characteristics, a monochromator, a real-time imaging detector for simplified alignment, and an energy-dispersive detector for collection of the K-edge data. The equipment, including the x-ray generator and detectors, is controlled by a personal computer. The same PC analyzes the raw data, with the result being made available to field personnel. Sensitivity comparable to the original laboratory tests was achieved, and measurement time was reduced by a factor of two. A 2-mm layer of uranium was successfully measured through 1 inch of steel. The K-edge system analyzed thorium contamination in seven drain lines in Wilhelm Hall. Minimal contamination was found in two lines, significant thorium contamination in three lines, mercury contamination in one line, and one case of a drain trap contaminated with uranium, thorium, and mercury. This was the first true in situ demonstration of the K-edge system. The K-edge system was subsequently demonstrated in the Savannah River Site LSDDP to measure the amount of highly enriched uranium (HEU) in the rooftop ventilation ducts for the Machining Room lathes. Sixty-six wide-angle images and 66 narrow beam spectroscopic shots were made during the demonstration. Approximately 84 feet of ventilation duct were assayed. When gram quantities were found, the precision was in the ±3 percent range. About one quarter of the narrow beam measurements identified a significant amount of HEU. An ITSR is available from the Savannah River Site LSDDP demonstration titled a "*Portable X-Ray K-Edge Heavy Metal Detector*," April 2000 (DOE-EM-0519).

Current Reporting Period Activities: The computer system for the K-edge data acquisition and analysis program was upgraded to allow the imaging system to run adequately under Windows 98. Tests of new device drivers for the motor control, image acquisition, and multi-channel analyzer cards were completed. Modifications to the graphical user interface were completed and documentation of the software package was initiated. Documentation of the K-edge software package was completed.

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OST/TMS ID 134

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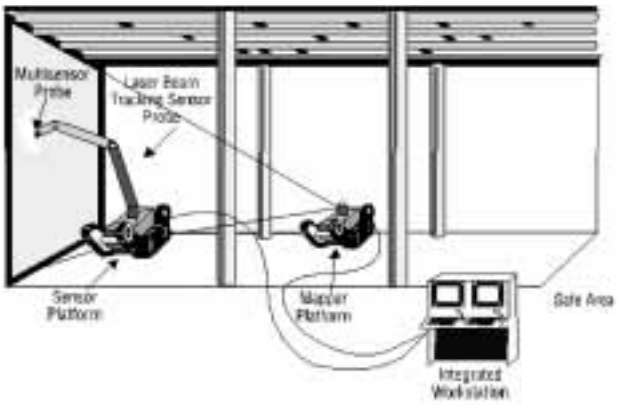
The K-edge technology is effective even through 1-inch-thick steel.

Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS)



Three-Dimensional Integrated Characterization and Archiving System (3-D ICAS) is a remote mapper and sensor platform to use in contaminated areas.

Objective and Scope: Coleman Research Corporation (Coleman) will develop a remote system that can rapidly analyze in situ hazardous organic and radionuclide contaminants on structural materials. This remote system is the Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS). The 3D-ICAS consists of a mobile sensor platform and a mobile mapper platform that operate in contaminated areas, and an integrated workstation that remains in a safe location. Development of this technology will occur in three phases.

Status and Accomplishments: The 3D-ICAS was successfully integrated with mobile platforms at Oak Ridge National Laboratory. The Coherent Laser Radar Mapper was operated on the OmniMate robotic platform and the contaminant analysis units and robot arm carrying the multisensor probe head were integrated on the overhead transporter. The system was subsequently demonstrated at Oak Ridge National Laboratory, Robotics and Process Systems Division in October 1998. The demonstration was conducted in the hi-bay area using a wall unit specially constructed for the demonstration. The wall unit consisted of pieces of cement-based wallboard and a small piece of an asbestos-containing material. The wall unit was purposely contaminated with low-levels of organic materials, alpha emitters, and a beta emitter. The demonstration consisted of mapping the wall unit, displaying the map, selecting points to be surveyed, running the contaminant survey which required moving the sensor/analysis unit with the transporter and acquiring the sensor unit with the 3D mapper, displaying the measured contamination in real time, and displaying detailed spatial and contamination data after the survey was completed. An unfortunate hardware failure the morning of the day before the demonstration prohibited acquisition of contaminant data from the high-speed gas chromatography/mass spectrometry (HSGC/MS) and only the Molecular Vibrational Spectrometer (MVS) provided real-time identification of the substrate material during the demonstration. This was a significant success since the MVS correctly identified the wallboard as being cement even though the particular substrate sample had not been included in the system's neural network training set. Failure of the HSGC/MS was unfortunate, but its performance had been well documented and demonstrated prior to the demonstration at ORNL and it did not detract from the main objective of the demonstration, which was to show end-to-end system operation with the 3D-ICAS mounted on ORNL mobile platforms. The GC/MS was shipped back to Thermedics and they are in the process of replacing the parts and recalibrating the system. When complete the system will be shipped to the DOE Environmental Measurements Laboratory in New York City for the validation testing.

Current Reporting Period Activities: The final integrated testing is being performed at the contractor's facility in Boston. After completion of this testing, the system will be tested at Florida International University at their mockup facility. The tests are expected to be complete by the early part of November 2000.

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OST/TMS ID 97

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Fast Response Isotopic Alpha Continuous Emissions Monitor

Objective and Scope: The objective of this effort is to develop and test Continuous Air and Emission Monitoring (CAEM) instrumentation for alpha-emitting radionuclides. This instrument will be designed in order to certify the proper performance of airborne emissions from ambient air and in equipment emissions encountered during D&D of DOE's surplus facilities. The proposed system will also meet the DOE's alpha CAEM requirements through the development of an innovative, high-resolution, on-line air/gas alpha monitor. The instruments will be capable of operating either as a stack emissions monitor, a process control instrument, or for the control of off-gas from decontamination, dismantlement, and air handling equipment.

Initial efforts will be focused on the development and evaluation of a rapid alpha-counting-based instrument to monitor ambient air and emissions to meet the monitoring and equipment control needs of surplus facilities undergoing decontamination and decommissioning. This development will establish the feasibility of a prototype instrument for use in detecting radionuclides that are present, or create susceptibility to exposure, throughout the DOE complex. The prototype instrument will be tested under the supervision of DOE's Inhalation Toxicology Research Institute in Albuquerque, New Mexico. Based on the prototype results efforts may be continued to full-scale commercial prototype for demonstration in one of DDFA's LSDDPs.

Informal meetings were held with various DOE CAEM end users. For example, the personnel associated with LANL's upgrade of their continuous air monitoring system for the Plutonium Facility at Technical Area 55 (TA-55) continue to be very interested in the further development of the Fast-Response CAEM. LANL was interested in hosting the Phase II field test in their back yard, at the LANL TA-54 LSDDP.

Current Reporting Period Activities: Modifications to improve the prototype CAM instrument's performance initiated during June were completed in August. This work included an improved detector mount for enhanced alignment of the detectors to the film, and an enhanced film tracking system to improve alignment of the film to the detectors. Several changes to the film transport system were also made to accommodate the enhanced film tracking system.

In order to improve the mechanical support of the film, a new film platen was fabricated, installed, and tested. The new platen was designed to be wider, in order to support the film for more of its travel through the instrument. In addition, the new platen was fabricated to produce a more even surface, with end-to-end surface elevation difference of less than 0.008". The more even surface was desired in order to decrease the gap between the detectors and the film, in order to improve the isotopic resolution of the laboratory prototype CAM instrument. As a result of the more even surface, it was possible to reduce the detector gap from 0.030" to 0.020".

The modified CAM instrument was successfully operated to obtain additional performance and reliability data. In brief, these tests included all the major operational features of the instrument:

- Two large area diodes, to maximize instrument sensitivity
- The improved, parallel-flow airflow arrangement described recently
- Automatic liberation of the instrument, to provide a sub-one minute response time for acute alarms of radionuclide levels
- An improved film support platen to provide improved isotopic resolution
- Automatic film feeding, to provide an archival record of radionuclide levels

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2.3 Facility Decontamination

High Productivity Vacuum Blasting System

Objective and Scope: The objective of this project is to improve the productivity and economics of existing vacuum blasting technology, which is used to remove radio-active contamination, PCB's, and lead-based paint and provides worker protection by con-tinuously recycling the material and dust from the decontamination tasks. This work will focus on re-designing and improving existing vacuum blasting components, including: blast headnozzles, ergonomic handling of the blast head by reducing its weight, brush-ring design, vacuum level regulator, efficiency of dust separator, and operational control sensors. The redesign is expected to enhance the productivity and economy of the vacuum blasting system by at least 50 percent of current vacuum blasting systems.

LTC Americas will develop the necessary mathematical models of air-particle flow in the nozzle, in the blast head and interface area, and in the dust separator to study the flow characteristics and interaction of the various elements of the system. The purpose of this model development is to increase the productivity and economy of existing vacuum blasting technology by 50 percent. Based on the results of this modeling effort, the contractor will experimentally test and verify that the above system components perform according to the mathematical simulations and complete the preliminary design of the components of the proposed system. This will include an overall configuration of the system including: material selection and testing, definition of the range of dimensional and weight parameters, conceptual arrangement or design of the blast head unit, and dust separator unit. Based on the prelim-inary design, the contractor will procure components, and perform fabrication and assembly of the proposed system.

The performance of the system will be evaluated in the laboratory mock-ups representing various clean-up situations and environments. The contractor will review, analyze, and interpret data collected from the tests and develop a productivity enhancement profile of the pre-prototype unit including economic analysis. Based on the laboratory test results, the contractor will modify, change, and make adjustments to enhance the capability of the system.

Status and Accomplishments: Phase I has been completed. In Phase I, mathematical models and related code to simulate the entire process numerically were developed. Based on the data from the model, an innovative rectangular nozzle and a new centrifugal separator were designed, manufactured, and tested. The tests were performed to verify the mathematical models. The numerical results agreed with the measured data with a devia-tion within 10 percent. Experimental results also showed that if the new inno-vative design rectangular nozzle replaces the old circular nozzle, more than a 50 percent increase in productivity efficiency could be achieved. The newly designed centrifugal separator offers a high-efficiency separation increase from about 30 to 75 percent, even using finer abrasives.

Phase II has been initiated. In Phase II, a pre-prototype of the nozzle, blast head with wind curtain, sensors and dust separator will be designed, constructed and tested to assess the performance of the new design under controlled conditions at the contrac-tor's facility.

Current Reporting Period Activities: The draft of the report on the results of Phase II has been received and is being reviewed. Phase II involved the test, at Florida International University (FIU), of the pre-prototype design of the improved high efficiency vacuum blasting system. The results show an improvement in productivity of 53 percent for concrete cleaning and 38 percent for steel plate over the original design. In phase III, which is the design and fabrication of a commercial prototype, the design features that were included in the pre-prototype and hindered improvements in productivity, such as heavy weight and poor handling characteristics of the nozzle head, will be removed. This should lead to increased improvements in productivity.

OST/TMS ID 2224

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2.4 Facility Dismantlement and Material Disposition

Asbestos Pipe Insulation Removal System (BOA)

Final Report: Carnegie Mellon University (CMU) developed a mechanical asbestos-removal system, dubbed BOA. BOA can be remotely placed on the outside of the pipe and can crawl along the pipe, wetting the asbestos-containing material (ACM), encapsulating and stripping the pipe, and bagging the removed insulation. Careful attention to vacuum and entrapment air flow ensures that the system can operate without a containment area while meeting local and federal standards for fiber-count.

The general configuration of the BOA system is that of an on-pipe self-locomoting removal head with an off-pipe control and handling system tethered to an off-board HEPA vacuum and liquids supply system. The removal head is manually placed with the assistance of a work-positioner, while the operator controls the robot via a touch-pendant. The removed insulation is vacuumed into a stationary HEPA vacuum system and manually bagged at the separator. The removal head can also be placed on pipes using a mobile boom-vehicle, allowing the system to work on pipes from 8 feet to 60 feet above ground.

BOA can travel on pipe of 3 to 4 inches in diameter; crawls past hangers unassisted; is helped around obstacles such as valves; cuts through various types of insulation cladding, such as plaster-tape, aluminum lagging, wire-mesh, plastic boots and pipe-clamps; adapts to inconsistent insulation thickness; and reduces fiber emissions to allowable level while feeding removed ACM and lagging into a vacuum-fed bagging and waste water separator system.

The BOA technology placed second in a national design competition hosted by the renowned Design News trade journal/magazine. BOA was selected from a large number of national entries and was judged one of the most innovative new designs and products in the United States in 1997/1998.

The first field demonstration of the BOA system was completed in August 1997 at the East Tennessee Technology Park, the former Oak Ridge K-25 Site. In the demonstration, controlled solely by local operators trained in the previous week, the system abated a 20-ft section of 4-in pipe in about 45 minutes, including simple paper and mast-coated CalSil insulation with wires, passing a hanger unaided as well as removing a section of aluminum-lagged, screwed-in, wired, and banded section of insulation.

A second demonstration of BOA was held at the Department of Defense's Pentagon Building in Arlington, Virginia during July 1999. The demonstration was performed initially on a mockup pipe and the asbestos insulation was removed successfully. However, when BOA started with the actual asbestos-covered pipe, the system worked initially and then failed because of the heavy canvas covering of the pipe. The crawler was jammed and when this happened, the water that was running continuously caused motor damage. The assessment from this demonstration concluded that the system performs well on asbestos but was not designed for the canvas wrapping of the asbestos pipe.

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Tech ID 148

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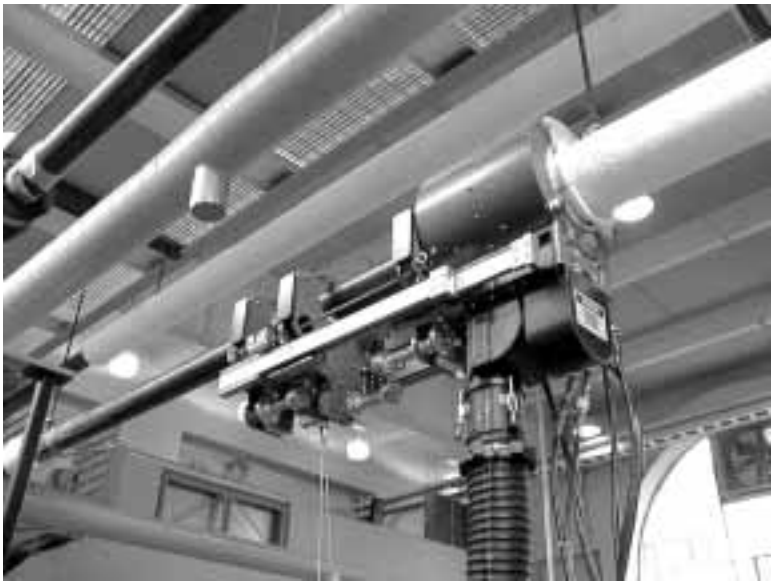
CMU's award-winning design for the Asbestos Pipe Insulation Removal Robot System dubbed BOA, is a pipe-crawling, asbestos-removal robot supported by a mobile, boom-vehicle



Robotics Crosscutting Program

Objective and Scope: The Robotics Crosscutting Program (Rbx) supports DDFA through technology development, close interaction with D&D Industry and University Programs funded through the National Energy Technology Laboratory (NETL), and introduction of new robotics technology into the DDFA's LSDDPs. Overall emphasis of the program continues to be design and integration of remote systems and capabilities used for facility deactivation and ongoing surveillance and maintenance activities with extended application to final facility D&D tasks. Deployment of remote D&D systems will reduce worker exposure to hazardous environments and provide productivity increases leading to substantial cost savings.

Status and Accomplishments: The major focus for Rbx in FY 2000 has been on three initiatives started in FY 1999. The first initiative, in support of the INEEL D&D program, will develop a low-cost D&D system that integrates the compact remote operator console with the Brokk demolition system to provide remote viewing and tool control capabilities.

The second new Rbx initiative is the development of telerobotic control capabilities for remote systems. Telerobotic control provides computer control of system operations, reducing the workload of the operator and increasing system effectiveness through more efficient execution of many tasks. The primary candidate for heavy manipulation in D&D is the Schilling Titan class hydraulic manipulator. DOE expertise in hydraulic control and robotic control systems provides an opportunity to enhance the control for the Schilling manipulators to allow telerobotic operation of these systems.

The final Rbx initiative started is the development of telerobotic systems for D&D of below-grade structures and equipment. There are many below-grade equipment enclosures (pits) with overhead access. Examples of such equipment pits are the filter pits at the INEEL and the much more numerous riser pits associated with the underground storage tanks at Hanford. The process cells within the canyon facilities are further examples of this type of environment. Most of these facilities have radiation or contamination levels that require remote operation for any characterization or D&D functions. These facilities represent target application sites for the telerobotic manipulation system based on the Schilling manipulator, the compact remote operator console and the telerobotic control capability.

Current Reporting Period Activities: INEEL Robotics staff completed a milestone (Milestone D&DA3) associated with the Modified Brokk Demolition Machine with Remote Console (Tech ID 2938). The goal of this investigation was to determine the feasibility of remotely changing various tools on the Brokk Demolition Machine and the ability of remotely controlling these tools through the Compact Remote Console. During the investigation, it was found that the Brokk vendor has recently incorporated the ability to remotely change tools on the Brokk through a remote change-out system. Also, the control system on the Modified Brokk Demolition Machine is an open architecture with the capability of adding additional devices, thus allowing additional features of these remote tools to be controlled from the Compact Remote Console. Efforts also continued to identify potential deployments of the Modified Brokk system at INEEL. Current plans include use of the INEEL D&D site operation's Brokk 250 to D&D the Test Area North (TAN) 616 Facility evaporator pit. Initial radiation surveys of this area indicate complete remote operation of the Brokk 250 will be required and early planning includes the use of the Modified Brokk to perform these D&D operations.

The Rbx D&D Product Line continues to support the LSDDP demonstration of two Russian technologies identified through the EM International Program; a Gamma Locating Detector and the Isotopic Identification Instrument. Current efforts include integration of the Russian technologies onto the robotic deployment (an IS Robotics ATRV-Jr) platform and mockup testing in preparation for late November demonstrations at the INEEL TAN-616 Facility.

Other activities during the reporting period included discussions between the Robotics D&D Product Line staff and the University of Texas at Austin (UT) robotics team researchers

to discuss long-term strategies for collaboration in telerobotics for D&D. The key issue is getting DOE-funded university and industry program R&D into systems that can be useful in the field. The UT-developed OSCAR robotics software is the key item of transfer under discussion at this time. OSCAR is a set of software tools that facilitates the generation of the necessary mathematics and high-level control software for robotics and obstacle avoidance. RoboWorks/RoboTalk is a graphical modeling package, written and recently commercialized by UT staff, which is actually separate from OSCAR but is used by OSCAR for graphical modeling of the manipulator. OSCAR should be compatible with the new PC104/QNX-based Schilling controller. Further review is necessary. This and other issues will be discussed at the upcoming University Robotics Program/Robotics Crosscut FY 2001 kick-off meeting scheduled for November 8-9 in Washington, DC.

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Tech ID 921

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2.5 Worker Safety and Other Projects

Protective Clothing Based on Permselective Membrane

Objective and Scope: Membrane Technology and Research, Inc. (MTR) is developing and demonstrating improved protective clothing that provides protection equivalent to current garments, but is lighter weight to improve comfort and is breathable to allow water vapor to escape, therefore reducing heat stress. Improved protective clothing will be made of an innovative fabric that combines an ultrathin, permselective outer membrane. The outer membrane is extremely permeable to water vapor escaping from the wearer, but highly impermeable to hazardous compounds. Fabric properties will be optimized and prototype suits well tested during Phase I. In Phase II, 20-30 suits will be fabricated and used in a variety of extensive, comparative trials in the laboratory and at a nonhazardous site.

Status and Accomplishments: Development of fabric materials and laboratory tests on the fabric have been completed. In laboratory tests, water vapor transmission rates of 600-900 g/m^2/day have been measured through the fabric. This water vapor transmission rate is far superior to butyl rubber suits with a water vapor transmission rate of 0-10 g/m^2/day. Chemical vapor transmission rates have been equal to or lower than the fabrics of commercial suits.

An innovative fabric combines an ultrathin, permselective outer membrane with a sorptive inner layer.

Two rolls of the fabric were laminated by Uretek. One roll of fabric (90 m by 30 in.), MTR1, uses rip-stop nylon as both inner and outer layers, and the second roll (40 m by 30 in.), MTR2, uses the rip-stop nylon on the outside and a flexible, lightweight, nonwoven fabric on the inside. The prototype suits manufactured by Kappler Systems received the following tests by outside laboratories: chemical permeation, physical properties, sweating mannequin, and heat stress modeling. In general, the results are not as good as expected: although the fabrics do combine water permeability and reduced heat stress with chemical protection, neither the chemical permeation resistance nor the reduction in heat stress were as high as hoped. The economic analysis was updated based on this new data. The analysis shows that MTR1 provides the greatest benefits in productivity; however, the benefit does not appear to justify the higher cost of the suit made of this fabric. MTR2 fabric has less productivity benefit and a higher selling price, and so is less attractive than MTR1.

The Phase II permselective garment testing by the International Union of Operating Engineers (IUOE) was concluded in August 1999. The garments tested, for personnel comfort and well-being of the worker while performing work, were those assembled by MTR's potential commercialization partner from the permselective fabrics supplied by MTR, Tyvek, and non-breathable garments like Saranex. The garments were all full bodysuits with hoods (for comparison purposes), and contained a more spacious cut in the chest and waist/crotch area than other manufactured garments, and this was very noticeable and appreciated by the test personnel. This also helped the garments to be more durable. Examples of tasks performed include crawling through confined spaces, performing metal grinding, and loading and hauling material in a wheelbarrow. The MTR garments, in general, were as comfortable, with respect to heat-stress, as the Tyvek garments, and extremely so, over the non-breathable garments. The test personnel all had very good comments concerning the MTR garments.

Current Reporting Period Activities: A recently updated draft report on the MTR garment testing last summer was received in late July. This is expected to relieve some of the schedule slippage problems. However, some will continue while MTR and their potential commercialization partner perform the economic analysis and the potential commercialization partner determines what they will or will not do in regards to commercializing the permselective membrane garment materials.

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Robot Task Space Analyzer (RTSA)

Final Report: The University of Tennessee (UT) has developed a promising way to achieve increased remote work-system efficiency by layering telerobotic technologies onto teleoperated remote systems. Robot Task Space Analyzer (RTSA) is an enabling technology necessary for the deployment of telerobotic automation in D&D. Automated dismantlement tasks involve reasoning about the 3D structure of the world and planning the motion of robots and tools. It therefore requires quantitative position, size, and shape information about equipment to be dismantled and other object surrounding it of which the robot needs to be aware. RTSA operates on the region of the world in which robotic dismantlement tasks are to be performed in the next several minutes.

Research and development of RTSA was conducted over two phases. In Phase I, laboratory-scale components of RTSA were developed and evaluated. Phase II involved the implementation and detailed evaluation of a complete RTSA system. Phase II showed that the stereo and range autoscan procedures could successfully find parts in regions selected by the operator and the coordinates of the parts were derived and returned to RTSA.

A technical overview document was developed describing the philosophy, hardware, and software used and contains appendices, which provide additional technical detail about the autoscan procedures, error and part placement results, and use of LINUX as a real-time operating system. A functions and requirements document was also produced which delineates the responsibilities of Carnegie Mellon University's (CMU) team and the desired functions of the finished RTSA code. This technology will be integrated with the Oak Ridge National Laboratory Pit Rise project.

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The Robot Task Space Analyzer will characterize the geometry of tasks for robots.

Integrated D&D Decision Analysis Tool

Objective and Scope: The objectives of this work are to develop a computer-based Survey Module, update the existing computer-based Decontamination and Decommissioning Technology Database Module, integrate the Survey Module and the D&D Technology Module and distribute the integrated software. FedTech, Arrey Industries, NES, and Research Triangle Institute have teamed to accomplish this effort. The existing D&D Technology Database Module being updated under this task was developed under a previous contract with Arrey Industries, NES, NEXI and Research Triangle Institute. The Survey Module will be able to cost effectively assist in preparation and execution of plans for initial facility surveys, operational surveys during D&D work and final facility release surveys. The Survey Module will estimate the budget, schedule, labor, radiation dose, waste generation, and equipment requirements to perform these surveys along with defining the number and location of survey points and recommended survey instruments. The Survey Module will integrate the collection, storage and reporting of survey data.

Current Reporting Period Activities:

No activity to report.

For more information:

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Modular Manipulator for Robotic Applications

Objective and Scope: This project focuses on the needs of Automated Plutonium Processing (APP) tasks that involve the manipulation of plutonium containers and the transfer of their contents. Specific challenges of APP glove boxes include restrictive entry ports, confined workspace, limited maintenance access and destructive plutonium particulates, which make this task virtually impossible to automate with existing technology.

In order for automation systems to be successful within DOE facilities; they must provide maximum functionality, flexibility, ease of use and reliability, while facilitating the rapid deployment of each custom system. This work concentrates on in-depth design and deployment of self-contained actuator modules, which will be used to construct a robotic manipulator tailored for APP tasks. A human-scale manipulator will be built from two sizes of DISC Actuator and will replace existing human labor within plutonium gloveboxes. The modular nature of ARM Auto-mation's technology readily enables installation and maintenance of automation within "hot" boxes.

Status and Accomplishments: A survey of the state-of-the-art modular manipulators design is completed. This survey addresses modular manipulators developed inside government laboratories, universities and private industry for such applications as space exploration or control research and commercially viable industrial applications. Based on this study, it is possible to define the requirements of one manipulator system that can be used to conduct automated transfer operations within plutonium glove boxes and some D&D applications.

Development of the test plan for testing the manipulator configuration was initiated. This effort included determining the best manipulator configuration to fit in a glovebox. A solid model of a glovebox was obtained from Sandia National Laboratory to aid in this effort. A path was then planned for the testing of the manipulator. Discussions are being conducted with the end users, and their requirements are being integrated in the final product.

Current Reporting Period Activities:

The inverse kinematics problem of the six-degrees-of-freedom (DOF) robot (with the first sliding joint disabled) has been solved using the generalized inverse in OSCAR and then sending the joint angles to Cimetrix. While this solution is adequate for simulation purposes, ARM is continuing to pursue more tightly integrated alternatives, such as a closed inverse, for control of the actual hardware. The integration of the obstacle avoidance with the manual controller is complete. The system works well in simulation (manual controllers and obstacle avoidance) and is waiting to be tested with the actual robot. The University of Texas (UT) has completed the glovebox model for obstacle avoidance including the basic interface to Cimetrix for obstacle avoidance. Also, UT has combined obstacle avoidance with the inverse kinematics and manual controller (Magellan) software into a demo to control the 6 DOF arm. In the demonstration, the obstacle avoidance does not permit any part of the robot to contact the glovebox.

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3.0 Programmatic Structure and Organization

Within the Environmental Management (EM) organization, the Office of Science and Technology (EM-50), formerly the Office of Technology Development, has the overall responsibility to develop and demonstrate technologies and systems to meet DOE's needs for environmental restoration and waste management. The office works closely with the EM Offices of Waste Management (EM-30), Environmental Restoration (EM-40), and Nuclear Materials and Facilities Stabilization (EM-60) in identifying, developing, demonstrating,and deploying innovative, cost-effective technologies and systems. Activities within EM-50 include research, development, demonstration, testing, and evaluation (RDDT&E); technology integration; technology transfer; and program support.

Program Structure

To focus DOE efforts on the most urgent needs, EM-50 has established four focus areas that address DOE's most pressing problems:

- Deactivation and Decommissioning (D&D)
- High-Level Waste Tank Remediation
- Mixed Waste Characterization, Treatment, and Disposal
- Subsurface Contaminants Containment and Remediation

In addition, EM-50 has established three crosscutting technology areas that conduct efforts where technology needs and targets are relevant to more than one focus area. The crosscutting areas are:

- Characterization, Monitoring and Sensor Technology (CMST)
- Efficient Separations and Processing (ESP)
- Robotics

"It's time we elevate the profile and prestige of this world-class facility, which has been helping solve energy and environmental problems for more than 50 years,"

Bill Richardson, U.S. Secretary of Energy, National Energy Technology Laboratory Dedication Ceremony

The Industry Program conducts competitively selected activities that involve the private sector in developing, demonstrating, and implementing improved technologies that address the needs of the focus areas and the crosscutting areas.

The result of this structure of programs is that the D&D Focus Area is positioned to support those research areas defined as highest priority by EM-50 and DOE customers.

The Role of NETL

The Federal Energy Technology Center, with physical sites in both Pittsburgh, Pennsylvania and Morgantown, West Virginia, was redesignated by U.S. Secretary of Energy Bill Richardson, as the National Energy Technology Laboratory (NETL). As the 15th national laboratory, NETL becomes part of the national laboratory research system. This is the largest research system of its kind in the world with more than 30,000 engineers and scientists conducting research and research and leading-edge experiments. As part of this system, the new National Ener

gy Technology Laboratory will join Argonne National Laboratory (Illinois); Brookhaven National Laboratory (New York); Lawrence Berkeley National Laboratory (California); Fermi National Accelerator Laboratory (Illinois); Idaho National Engineering & Environmental Laboratory (Idaho); Lawrence Livermore National Laboratory (California); Los Alamos National Laboratory (New Mexico); National Renewable Energy Laboratory (Colorado); Oak Ridge National Laboratory (Tennessee);
Pacific Northwest National Laboratory (Washington); and Sandia National Laboratories (New Mexico and California).

Rita A. Bajura, NETL Director, a career federal executive with more than 18 years experience in government-industry energy partnerships, continues in her leadership position as head of the single management team that serves both physical sites with a combined working force of more than 530 federal scientists, engineers, and administrative staff. NETL is responsible for nearly 600 research projects; most

involving the development of advanced fossil fuel technologies.

In addition to the new national laboratory's core capabilities, Secretary Richardson announced that a newly created Center for Advanced Natural Gas Studies, would be an integral part of NETL's research endowment.

Senator Robert C. Byrd, (WV) remarked in the course of the dedication that, "Much of the laboratory's work is dedicated to the worthy goal of developing innovative, clean and efficient technologies that will allow our nation to meet its growing energy needs. As the nation's newest national laboratory, it will continue to help light a pathway for a new era of energy use that will ensure a comfortable standard of living for our children and our children's children."

NETL also manages a significant portion of the technology development needed to clean up sites in the government's nuclear weapons complex. In February 1995, the then Morgantown Energy Technology Center was selected by EM-50 to be the implementing organization for the D&D Focus Area. As such, it brought the experience gained from being the implementing organization for the Industry Program, which competitively selects industrial R&D performers through Research Opportunity Announcements (ROAs) and Program Research and Development Announcements (PRDAs). As the lead organization for D&D implementation, NETL is responsible for the planning, monitoring, and evaluating RDDT&E projects to meet the requirements of EM-50 and its customers in EM-30, EM-40, and EM-60.

▼ Stakeholder Feedback

The stakeholders in the D&D Focus Area include DOE headquarters; DOE operations offices; DOE sites and their operating contractors; D&D technology developers and users in the private sector; federal, state, and local regulators; and the communities around affected DOE facilities. These stakeholders have been providing input to focus area planning and implementation; program contacts are provided on the first page of this report.

4.0 Background

The D&D Focus Area was established to develop and demonstrate improved technologies and systems that could solve customer-identified needs to characterize, deactivate, survey and maintain, decontaminate, dismantle, and dispose of or recycle DOE surplus facilities and their contents. The mission also includes facilitating the acceptance, approval, transfer, commercialization, deployment, and implementation of these technologies and systems.

These technologies are needed to address the pressing needs of deactivating more than 7000 contaminated buildings and decommissioning more than 700 buildings. In addition, material disposition is required for over 600,000 tons of metal and 23 million cubic meters of concrete in contaminated buildings and for 400,000 tons of metal currently in scrap piles. The major drivers for this focus area are the high safety and health risks associated with working in aged and contaminated facilities and the high costs associated with facility deactivation, sur-veillance, and maintenance using currently available baseline technologies.

D&D Focus Area Strategy

Subsequent to the selection of NETL as the lead organization for the D&D Focus Area, a program review of all FY95 projects was held in May 1995. Based on this and other recent program reviews, as well as the general requirement for fiscal constraint throughout, the following strategies were developed:

Programmatic Strategy

- Focus D&D technology development program on large-scale demonstrations emphasizing full-scale demonstrations using a suite of improved technologies.
- Demonstrate technologies only through large-scale demonstrations.
- Focus on technologies that are identified as high priority by customers, that have wide applicability, and that have a commitment to be considered for use by customers.
- Emphasize demonstration and deployment of private-sector technologies.
- Technical Strategy

In the near term, emphasize technologies to effectively support:

- deactivation of facilities,
- decontamination of surfaces,
- reuse of bulk contaminated materials,and
- application of remotely operated dismantlement systems

In the middle term, emphasize technologies to effectively support:

- applications of remote surveillance systems,
- characterization of volumetrically contaminated materials,
- decontamination of bulk materials, and
- adoption of release standards for bulk contaminated materials.

Large-Scale Demonstrations

A cornerstone of the D&D Focus Area is its series of large-scale demonstration and deployment projects. The LSDDPs demonstrate innovative and improved D&D technologies at full scale, side by side with existing commercial technologies. The intent is to compare benefits from using a suite of improved and innovative D&D technologies against those associated with baseline D&D technologies. This approach provides an opportunity to test improved and innovative D&D technologies at a scale that will provide meaningful cost and performance information to the potential end-users of the technology.

5.0 Upcoming Events

February 2001

Waste Management 2001

February 25–March 1, 2001
Tucson, AZ

March 2001

American Nuclear Society (ANS) 9th International Topical Meeting on Robotics and Remote Systems

March 4–8, 2001
Seattle, WA

April 2001

DDFA Midyear Review and Decommissioning Symposium Florida International University

April 17-19, 2001
Conference Center, North Campus
Miami FL

American Nuclear Society (ANS) 9th International High-Level Radioactive Waste Management Conference (IHLRWM)

April 29–May 3, 2001
Las Vegas, NV

June 2001

American Nuclear Society Annual Meeting

June 18–21, 2001
Milwaukee, WI

September 2001

American Nuclear Society Decommissioning, Decontamination & Reutilization Meeting

September 23–27, 2001
Knoxville, TN

November 2001

American Nuclear Society Winter Meeting

Nov. 11–15, 2001
Reno, NV

We list conferences and workshops of interest to our readership. Please let us know if you would like us to include your event on this page.

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